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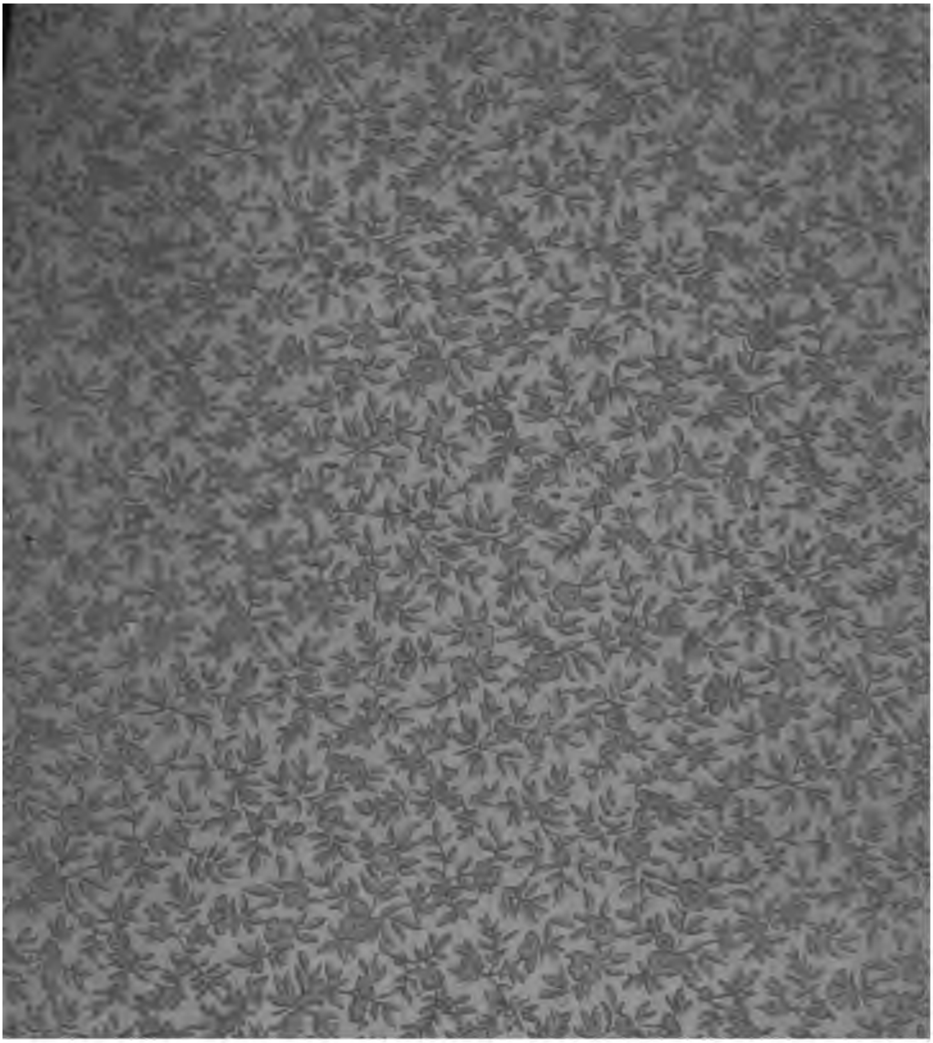

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GEOLOGICAL SURVEY OF NEW JERSEY.
HENRY B. KÜMMEL, STATE GEOLOGIST.

REPORT ON PALEONTOLOGY.

VOLUME III.

THE PALEOZOIC FAUNAS.

BY

STUART WELLER, PH.D.

TRENTON, N. J.:
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To His Excellency Franklin Murphy, Governor of the State of New Jersey and ex-officio President of the Board of Managers of the Geological Survey:

SIR—I have the honor to submit a report upon the Paleozoic Paleontology of New Jersey, with the request that it be printed as an Appendix to my Annual Report for the year 1902.

Yours respectfully,

HENRY B. KÜMMEL,

State Geologist.

TRENTON, N. J., November 29th, 1902.

Preface.

The report upon the fossils of the Paleozoic formations of New Jersey forms Volume III. of the Paleontology Reports of the State Geological Survey. The previous reports of this series—Volume I., The Brachiopoda and Lamellibranchiata of the Raritan Clays and Greensand Marls, by R. P. Whitfield; and Volume II., The Gasteropoda and Cephalopoda of the Raritan Clays and Greensand Marls, by the same author—were prepared and published in co-operation with the United States Geological Survey. They appear, also, as United States Geological Survey Monographs IX. and XVIII., respectively. Although this report—Volume III.—was written and published under the direction of the present State Geologist, it is proper to state that the field work was commenced and carried on in 1899 and 1900, while Professor John C. Smock was State Geologist.

The Paleontology Reports are distributed to libraries, geologists and other surveys. Volume III. will be sent upon request, also, to those especially interested in this subject. A few copies of Volumes I. and II. of this series are still undistributed, and libraries are urged to notify the State Geologist of gaps in their sets of survey reports. The reports are distributed without cost, except that transportation charges are paid by the recipient.

The subject matter of the Paleontology Reports is of a more specialized nature than of some of the volumes of the Final Report series—*i. e.,* the Report on the Physical Geography of the State, Volume IV.; and on Glacial Geology, Volume V.; nor is it of such direct economic value as the Report on Water-supply, Volume III.; and the Report on the Clay Industry, now in preparation. Nevertheless, a knowledge of the fossils contained in the rocks of the State is of no little importance. The age of the formations, their correct stratigraphical position, and the conditions under which they originated, are, in part, to-be determined by a study of their fossil contents. Correct inferences as to their economic value and the ready and accurate determination of their occurrence depend largely upon a precise knowledge of these points.

A striking example of this indirect economic value of paleontological studies was seen in connection with these very investigations. Very early in the work it was found that the earthy limestone, so extensively used in the vicinity of Phillipsburg for the manufacture of Portland cement, as well as the pure non-magnesian limestone used with the cement rock to increase the percentage of lime, belonged to the Trenton formation, and was readily recognized by the fossils it contained. It was found to occupy a definite position in respect to the underlying Kittatinny limestone, which was highly magnesian and of no value for Portland cement, and the overlying Hudson River slate. This fact being determined, it was a comparatively rapid and easy matter to trace the boundaries of the formation and so determine the location of these beds. It was at once possible to eliminate a large area from the field of investigation, with great saving both of time and money. In fact, the Report upon the Portland Cement Rocks* could not have been prepared, without the expenditure of a much greater sum than was involved, if it had been necessary to examine the whole area of Paleozoic rocks with as much detail as was given to a few comparatively narrow zones.

But even if the study of these faunas were totally unproductive of any economic results, direct or indirect, nevertheless, their investigation is a legitimate part of the Survey work. It is worthy

A REPORT

ON THE

PALEOZOIC PALEONTOLOGY

OF

NEW JERSEY.

By STUART WELLER, Ph.D.

Introduction.

The present report on the Paleozoic Paleontology of New Jersey consists of two parts. Part I. covers the Stratigraphic Paleontology. The several geologic formations recognized in the State are described, lists of their included fossils are given and the characteristics of their fossil faunas are discussed with a view of establishing correlations between the Paleozoic formations of New Jersey and those of other regions. The detailed geographic distribution of the formations and their geologic structure are not considered in the present report, but many facts of distribution and structure have been given in a report upon "Portland Cement," published in the Annual Report of the State Geologist for 1900, and in a report upon "The Rocks of the Green Pond Mountain Region," in the Annual Report for 1901.

Part II. of the report is devoted to Descriptive Paleontology. In this part the fauna of each formation is taken up in detail, each one of its species being fully described and illustrated on the accompanying plates. This part includes the descriptions of many species previously described elsewhere, as well as the descriptions of a considerable number of new species here published for the first time. With the descriptions of old species one or more references to the literature of the species are always given, but no attempt at a complete bibliography has been made. The references usually selected are those which will direct the reader to additional illustrations which will be helpful in the identification of the species. For a complete bibliography of the Brachiopoda, to which class of organisms a large number of the species described in the present volume belong, the reader is directed to Bulletin No. 87 of the United States Geological Survey, entitled "A Synopsis of American Fossil Brachiopoda, including Bibliography and Synonymy," by Charles Schuchert. Those readers who desire a full discussion of the characteristics of the various Branches, Classes, Orders and Families of the fossil organisms described are referred to any one of the several text-books of paleontology, the best one for

American students being Eastman's translation of "Zittel's Text-Book of Paleontology," published by Macmillan & Company.

Most of the drawings accompanying Part II. have been prepared by Miss Mildred L. Marvin. A few have been made by Miss Annie L. Weller and Mr. D. F. Higgins, and the writer himself has contributed a small number.

PART I.

Stratigraphic Paleontology.

CHAPTER I.

GENERAL RELATIONS.

The Paleozoic rocks of New Jersey fall naturally into three geographic divisions. The first of these is the Delaware valley area, lying to the northwest of the Kittatinny mountain, between the crest of the mountain and the Delaware river; the second area is the Kittatinny valley, lying between the Kittatinny mountain on the northwest and the crystalline highlands on the southeast; the third division includes several smaller outlying areas within the region occupied by the Pre-cambrian crystalline rocks, which are entirely surrounded by the crystalline rocks or by the crystalline rocks on one side and the Triassic sandstones on the other. The areas of paleozoic sedimentary strata within the crystalline highlands occupy the valleys of the Musconetcong and Pohatcong rivers, the valley of the South Branch of the Raritan river from Califon northeastwardly to beyond German Valley, and the area known as the Green Pond mountain region, which extends from near Port Oram northeastwardly to the New York State line at Greenwood lake, having its greatest width a little south of Newfoundland. Between the German Valley and the Green Pond mountain regions there are several additional, much smaller areas. On the border between the crystalline highlands and the red Triassic sandstones there is a small area extending northeast for a short distance from the Delaware river at a point about two miles south of Riegelsville, another at Little York, another of considerable extent extending from Pattenburg eastwardly to beyond Clinton. There is a small area about Pottersville and another larger one extending northeastwardly from Peapack. With the exception of the Green Pond mountain region, the geologic formations of all of these outlying areas are essentially the same as those in the Kittatinny valley, but in the Green Pond mountain regions several conspicuous geologic formations occur which are seen nowhere else in the State.

The geologic formations of the Delaware valley area are all of Silurian and Devonian age, covering a period extending from the time of deposition of the Shawangunk conglomerate, which was the beginning of Silurian time, to that of the Onondaga limestone, which represents the first half of middle Devonian time. In the Kittatinny valley and in all of the outlying areas, except the Green Pond mountain region, the formations are of Cambrian and Ordovician age. The greatest range of geologic formations occurs in the Green Pond mountain region, where there are Cambrian strata as old as any in the Kittatinny valley, and Devonian strata younger than any in the Delaware valley.

In the following table the geologic formations of Paleozoic age in New Jersey have been arranged in sequence, and in the following pages their paleontologic characters will be discussed in order, beginning with the oldest and proceeding to the youngest. In the table the formations of the Delaware valley area are placed in one column, those of the Kittatinny valley and all of the outlying areas, except the Green Pond mountain region, in another, and those of the Green Pond mountain region in a third column.

Delaware Valley.	Kittatinny Valley.	Green Pond Mountain Region.
Cambrian.	*Cambrian.*	*Cambrian.*
	Hardyston quartzite.	Hardyston quartzite.
	Kittatinny limestone (part).	Kittatinny limestone.
Ordovician.	*Ordovician.*	*Ordovician.*
	Kittatinny limestone (part).	
	Trenton limestone.	
	Hudson River slate.	
Silurian.	*Silurian.*	*Silurian.*
Shawangunk conglomerate.		Green Pond Mountain conglomerate.
Medina sandstone.		Longwood shale.
Poxino Island shale.		Decker Ferry formation.
Bossardville limestone.		
Decker Ferry formation.		
Rondout formation.		
Manlius limestone.		
Devonian.	*Devonian.*	*Devonian.*
Coeyman's limestone.		
New Scotland beds.		
Stormville sandstone.		
Becraft limestone.		
Kingston beds.		
Oriskany formation.		
Esopus grit.		
Onondaga limestone.		Newfoundland grit.
		Monroe shales.
		Bellvale flags.
		Skunnemunk conglomerate.

The names used for the formations in New Jersey have in most cases been adopted either from New York or from Pennsylvania, into which States the New Jersey formations extend, and where they have been more or less carefully studied and described in the literature.

CHAPTER II.

FORMATIONS OF CAMBRIAN AGE.

HARDYSTON QUARTZITE.

Wherever the sedimentary Paleozoic strata lie normally against the pre-cambrian crystalline rocks without faulting, both in the Kittatinny valley and in the outlying areas, the beginning of the sedimentary series is a rock with exceedingly variable lithologic characteristics, but always highly siliceous. In some localities it is a quartzite, sometimes it is a conglomerate, often an arkose, and in its upper layers it becomes more and more calcareous, with some shaley beds. This formation is known in New Jersey as the Hardyston quartzite. It was first named the Hardystonville quartzite by Wolff and Brooks,* but an abbreviation of the name to Hardyston seems desirable. The same formation extends into Pennsylvania, where it is known as the Chiques sandstone,† and similar beds extend southward along the Appalachians.

In New Jersey the thickness of the formation is as variable as its physical characters. Wolff and Brooks ‡ gave its thickness as ranging from "thirty feet to a foot or less," but their observations were restricted to the region about Franklin Furnace. In other parts of its outcrop the conglomeritic phase of the formation is known to equal

Olenellus always being the most conspicuous form. During the field investigations carried on for the preparation of the present report, fossils have been found (1) at various points along the line between Hardystonville and Frankville Furnace, (2) at the southern end of Iliff's pond, north of Andover, (3) at the foot of the mountain east of Tranquility, (4) in the railroad cut just north of Oxford Furnace and (5) in the railroad cut at Washington. Aside from some more or less indefinite worm burrows, all of the fossils detected have been trilobites, referable to a single species of *Olenellus*, which has been identified as *O. thompsoni*. Except at the localities near Franklin Furnace and Hardystonville, where several nearly perfect heads of *Olenellus* have been found, all of the specimens are in fragmentary condition. Wherever they occur the specimens of trilobites have always been found in the decomposed portions of the more calcareous beds of the formations. In the process of weathering the calcareous portion of these beds is removed by solution, leaving a more or less friable, rusty brown sandstone. The tests of the trilobites are removed with the other calcareous matter, leaving cavities, along which the rock easily splits; but in the unweathered portions of the rock the fossils have in no case been detected, although they must be present in greater or less abundance. Field observations have led to the conclusion that whenever the decomposed beds of the Hardyston quartzite present a rusty brown appearance, with a rather fine-grained, arenaceous texture, fragments of *Olenellus* may be detected in greater or less abundance if careful search is made.

The formation occurs in the Green Pond mountain region, and its upper calcareous portion or the limestones immediately superjacent to it have afforded fragments of *Olenellus*.* At the time of its deposition the formation was doubtless continuous across the present crystalline highlands, from the Green Pond mountain region to the Kittatinny valley.

KITTATINNY LIMESTONE.

Lying conformably upon the Hardyston quartzite there is a great thickness of limestone in large part dolomitic and rarely fossiliferous. The division between the quartzite below and this limestone is not a sharp one, the siliceous Hardyston beds becoming more and more calcareous in their composition, through strata of arenaceous limestone or calcareous sandstone and shales. This limestone formation has a great thickness, which is estimated at from 2,700 to 3,000 feet. It is designated the Kittatinny limestone* because it is the great limestone formation of the Kittatinny valley, where it occupies extensive areas. It is also present in all of the outlying areas. Like the Hardyston quartzite, this limestone formation was doubtless at one time continuous across the area now occupied by the crystalline highlands, and has been eroded. It is continuous across Pennsylvania, where it has been described as the Great Valley limestone, No. II.,† and across Maryland and the eastern part of West Virginia into Virginia, where it is known as the Shenandoah limestone.‡ The formation also extends northward from New Jersey into New York.

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* Walcott, Am. Jour. Sci. (3), vol. XLVII., p. 309.

The fossil fauna of the Kittatinny limestone, so far as it is known, is not an extensive one. Although organic remains have been found at but few localities, they are sufficient to establish the age of the formation as Cambrian for the most part. At one locality, near the summit of the formation, however, a fauna indicating the early Ordovician age of the beds containing it has been collected.

The largest fauna of Cambrian age which has been discovered in the formation is that from O'Donnell and MacManniman's quarry, at Newton (Locality 136 A), where the following species have been collected:

Foraminifera? genus and sp. undet.
Lingulella stoneana Whitf.
Orthis newtonensis n. sp.
Microdiscus? sp. undet.
Olenellus? sp. undet.

is not associated with the other species, but occurs in a bed a few feet higher in position, is a Wisconsin form, of peculiar type, which is now recognized for the first time from the east. The association with a well-defined species of *Dikelocephalus,* of the species which has here been referred to the genus *Olenellus,* would be of much greater interest if the identification could be made with certainty, but, in any case, it suggests the possibility of a much longer range for the genus *Olenellus* in geologic time than has been ascribed to it. This genus is usually considered as particularly characteristic of the very lowest Cambrian strata, but here it seems to be associated with a fauna which bears unmistakable marks of upper Cambrian age.

In A. J. Graey's quarry (Locality 136 C), just south of Newton, a few imperfect specimens of the brachiopod, described as *Orthis newtonensis,* have been detected; and again, the same species has been found in an abandoned quarry north of Andover, near the Delaware, Lackawanna and Western railroad, west of Long pond (Locality 158 C). In neither of these localities have any trilobites been found associated with the brachiopods.

About one-half mile north of Blairstown (Locality 175 A), in an abandoned quarry, a bed about one foot in thickness was found to contain many fragments of trilobites, and the following species have been identified:

Agraulos saratogensis Walc.
Ptychoparia blairi n. sp.
Ptychoparia calcifera Walc.?

Of these species one is described for the first time in the present report, the other two being identified with species described by Walcott from the upper Cambrian limestones of Saratoga county, New York.

One other fossiliferous locality in the Cambrian portion of the Kittatinny limestone has been found in Robinson Brothers' quarry, south of Carpentersville (Locality 341 A). This locality is situated in one of the outlying areas of the limestone, occupying the valley of the Pohatcong river; only one species, *Solenopleura jerseyensis* Weller,* has been found, which was described for the first time from this locality.

The position of these various fossiliferous beds of the Kittatinny limestone, in the formation as a whole, cannot be determined with certainty, but it may probably be stated, with a degree of safety, that

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*** In the Annual Report of the State Geologist for 1899 this species is doubtfully referred to the genus *Liostracus.***

all of these fossiliferous localities, with the exception of that near Carpentersville, are in the upper portion of the formation. The Carpentersville locality is probably somewhere in the lower third of the entire series. So far as the fossils afford any definite evidence, the age of all is upper Cambrian. No middle Cambrian faunas have been recognized, although the *Olenellus* fauna of the Hardyston quartzite is usually considered to be of lower Cambrian age, and a middle Cambrian fauna would naturally be expected to occur somewhere in the formation.

CHAPTER III.

FORMATIONS OF ORDOVICIAN AGE.

KITTATINNY LIMESTONE.

The top of the Kittatinny limestone in New Jersey is not a continuous horizon, as there is an erosion interval between it and the Trenton limestone, the next succeeding formation. At many localities the highest beds are doubtless Cambrian in age, but the remnants of beds bearing a younger fauna than that characterized by *Dikelocephalus* are present in at least one locality. These strata seem not to be separated by any physical break from those bearing the Cambrian fauna, and the deposition was doubtless continuous from early Cambrian time until after the opening of the Ordovician, as usually understood. The single locality in the Kittatinny limestone which has afforded this early Ordovician fauna is in the railroad cut of the Delaware branch of the New York, Susquehanna and Western railroad at Columbia (Locality 210 A). The limestone at this point is somewhat thinner bedded than usual for the formation, the beds being frequently separated by thin, shaley partings. Similar strata occur along the railroad at Hainesburg, near the top of the formation, and they, too, may be of Ordovician age, although no fossils have been found at that locality. At Columbia the Trenton limestone outcrops only a short distance up the hillside from the railroad cut where the fossils occur, so that the position of the fauna near the top of the Kittatinny limestone formation is assured. The following species of fossils have been recognized:

Dalmanella wemplei Cleland.
Dalmanella electra (Bill.).
Syntrophia lateralis (Whitf.).
Cyrtolites sinuatus H. & W.
Bellerophon sp. undet.
Raphistoma columbiana n. sp.
Liospira sp. undet.
Ophileta? sp. undet.

Eccyliomphalus subelliptica n. sp.
Polygyrata sinistra n. sp.
Platyceras? columbiana n. sp.
Cyrtoceras sp. undet.
Isotelus canalis (Whitf.).
Illænurus columbiana n. sp.
Bathyurus? sp. undet.

This fauna contrasts sharply with the Cambrian fauna of the Kittatinny limestone, by reason of the predominance of gastropods, a characteristic in which the fauna agrees with that of the Beekmantown limestone of New York in most of its localities.

Of the species identified with already-described forms, two, *Syntrophia lateralis* and *Isotelus canalis,* occur in the beds of Beekmantown age at Fort Cassin, on Lake Champlain. One species, *Dalmanella electra,* was described from the Levis beds of similar age on the St. Lawrence river, near Montreal. *Dalmanella wemplei* was described from the same horizon at Fort Hunter, New York, in the Mohawk valley; this species, however, is closely allied to, and perhaps should be considered as identical with, *D. macleodi* (Whitf.), from the typical Beekmantown limestone at Beekmantown, New York. *Illænurus columbiana,* also, occurs at Fort Hunter, New York, but has been described from there under another name. *Cyrtolites sinuatus* was originally described from the Pogonip limestone of Nevada. Aside from these species, which are identical with forms in the Beekmantown limestone of New York and Canada, all of the new species described have their nearest allies in the same fauna, and there can be no question whatever as to the correctness of the correlation of the always be detected between the two. The average thickness of this formation is from 135 to 150 feet, and although it is a limestone, it is very different in character from the subjacent Kittatinny limestone. Chemically it is a nearly pure calcium carbonate, while the Kittatinny limestone is almost always highly magnesian. It becomes, however, an argillaceous limestone in the transition beds to the overlying shale. It is usually much darker in color than the Kittatinny limestone and almost always contains fossils, although they are frequently fragmentary and poorly preserved. The formation was described by Professor Cook* as the fossiliferous limestone and its Trenton age has long been recognized. It rests unconformably upon the Kittatinny limestone, the two formations being separated by an erosion interval, and in its lower beds it is frequently conglomeritic, the pebbles being from the underlying Kittatinny limestone. In some localities, where it is not conglomeritic at the base, its lower portion consists of fine, clastic material, apparently derived from the underlying Kittatinny limestone. In many localities the formation is apparently absent, the Hudson River slates resting directly against the Kittatinny limestone, but in all these cases its absence is due to overthrust faulting.

A large number of fossil species have been recognized in the formation at its various localities in the State, and a critical study of its faunas shows that it is not strictly equivalent to the typical Trenton limestone of New York, but that it also includes somewhat older beds of the age of the Black River limestone. The entire formation, however, in New Jersey constitutes a single stratigraphic unit, and this unit may be considered as being the equivalent of the Black River and Trenton limestones of New York, although the top of the formation in New Jersey is doubtless lower down in the series than the summit of the typical New York Trenton limestone.

Several distinct faunal zones have been recognized in the formation. The outcrops, however, are usually more or less isolated knolls, and are usually so fully covered with *debris* that fossils can be collected only from loose fragments of the limestone on the surface. It is also rare to find more than a single faunal zone in any one outcrop. Under these circumstances the determination of the exact succession of the faunal zones has been a problem of some difficulty. The locality selected for a detailed investigation of the succession of fossil faunas in the formation is a hill, 580 + feet in elevation, on the property of Mr. E. J. Hough, just back of the mill at Jacksonburg, near Blairstown (Locality 174 A). At this locality the formation is more than ordinarily fossiliferous and the fossils are better preserved than usual. On the lower slope of the hill the Kittatinny limestone is exposed and in the knoll just beyond the slate outcrops, so that the entire thickness of the formation is present. A trench was dug, in order to expose a continuous section of the formation from its contact with the Kittatinny limestone, through a thickness of 122 feet. At this point in the section, although the top of the limestone had not been reached, the trench was discontinued, because the rock surface dipped so deeply beneath the surface of the ground that further digging was impracticable. It is probable that fifteen or twenty additional feet of limestone are present in the section before it passes into the overlying Hudson River slates. This section was accurately measured, sixty-one different beds being recognized, from each of which fossils were carefully collected. This Jacksonburg section through the Trenton limestone will be given first consideration in the discussion of the Trenton faunas, it being the key to the determination of the faunal succession in this formation in New Jersey.

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* Geol. N. J., 1868, p. 131.

*Locality 174 A.—The Jacksonburg Section.**

174 A^1.	Fine-grained, buff-colored, shaley beds, the constituent material apparently having been dederived from the underlying Kittatinny limestone.	2 ft. 2 in.

174 A^2. Fine-grained, chocolate-colored, shaley beds, similar to the last in all respects except color. 1 ft. 6 in.

1. *Strophomena* sp. undet. (r).
2. *Refinesquina alternata* (Emm.) (r).
3. *Dalmanella subæquata* (Con.) (aa).
4. *Ctenodonta* sp. undet. (r).
5. *Modiolopsis jerseyensis* n. sp. (r).
6. Undet. pelecypods (r).
7. *Pterygometopus intermedius* Walc. (r).
8. *Leperditia fabulites* (Con.) (a).

174 A^3. Chocolate-colored, calcareous band. 3 in.

1. *Dalmanella subæquata* (Con.) (a).
2. *Lophospira* sp. undet. (r).
3. *Leperditia fabulites* (Con.) (a).

174 A^4. Brownish, calcareous shale. 1 ft. 3 in.

1. *Lingula* sp. undet. (r).
2. *Strophomena* sp. undet. (r).
3. *Rafinesquina alternata* (Emm.) (r).
4. *Dalmanella subæquata* (Con.) (aa).
5. *Scenidium anthonensis* Sard. (r).
6. *Ctenodonta* sp. undet. (r).
7. *Cyrtodonta* sp. undet. (r).
8. *Modiolopsis* sp. undet. (r).
9. *Phragmolites* sp. undet. (r).
10. *Helicotoma* sp. undet. (r).
11. *Orthoceras* sp. undet. (c).
12. *Pterygometopus intermedius* Walc. (r).
13. *Leperditia fabulites* (Con.) (a).

174 A^5. Fine-grained, buff-colored, shaley bed. 1 ft. 6 in.

1. *Dalmanella subæquata* (Con.) (a).
2. Undet. pelecypod fragments (c).
3. Undet. gastropod fragments (c).
4. *Orthoceras* sp. undet. (c).
5. *Leperditia fabulites* (Con.) (a).

174 A⁶. Buff or chocolate-colored, shaley beds, similar to the preceding, with some bands of darker limestone. 7 ft.

1. *Dalmanella subæquata* (Con.) (aa).
2. *Ctenodonta nasuta* (Hall) (r).
3. Undet. pelecypod fragments (c).
4. Undet. gastropod fragments (c).
5. *Ptychopyge jerseyensis* n. sp. (r).
6. *Leperditia fabulites* (Con.) (a).

174 A⁷. Hard, fine-grained, dark, bluish-gray limestone. 1 ft. 8 in.

1. *Leperditia fabulites* (Con.) (r).

174 A⁸. Fine-grained, buff-colored, shaley beds, with hard, calcareous bands. 4 ft.

1. *Modiolopsis* sp. undet. (r).
2. *Leperditia fabulites* (Con.) (c).

174 A⁹. Soft, fine-grained, bluish-gray limestone. 3 ft. 6 in.

1. Undet. bryozoan (r).
2. *Rafinesquina alternata* (Emm.) (r).
3. *Dalmanella subæquata* (Con.) (r).
4. *Camarella inornata* n. sp. (r).
5. *Modiolopsis* sp. undet. (r).
6. *Raphistoma peracutum* U. & S. (r).
7. Undet. gastropod fragments (r).
8. *Bumastus trentonensis* (Emm.) (r).

9. *Lophospira oweni* U. & S. (r).
10. *Isotelus gigas* De Kay (f).
11. *Bumastus trentonensis* (Emm.) (c).
12. *Ceraurus pleurexanthemus* Green (f).
13. *Pseudosphærexochus trentonensis* Clark (r).
14. *Pterygometopus* sp. undet. (r).
15. *Leperditia fabulites* (Con.) (c).

174 A^{11}. Soft, bluish-gray limestone, similar to the last. 4 ft.

1. Undet. bryozoan (r).
2. *Lingula* sp. undet. (r).
3. *Rafinesquina alternata* (Emm.) (a).
4. *Dalmanella subæquata* (Con.) (c).
5. Undet. pelecypod fragments (r).
6. *Isotelus gigas* De Kay (r).
7. *Leperditia fabulites* (Con.) (r).

174 A^{12}. Soft, bluish-gray limestone, similar to the last. 6 ft.

1. *Hindia parva* Ulr. (f).
2. *Streptelasma corniculum* H. (r).
3. *Rhinidictya* sp. undet. (c).
4. *Strophomena incurvata* (Shep.) (r).
5. *Dalmanella subæquata* (Con.) (r).
6. *Scenidium anthonensis* Sard. (f).
7. *Bumastus trentonensis* (Emm.) (r).
8. *Leperditia fabulites* (Con.) (r).

174 A^{13}. Hard, bluish-black limestone. 8 ft. 4 in.

1. *Romingeria? trentonensis* n. sp. (r).
2. *Bucania* sp. undet. (r).
3. *Bumastus trentonensis* (Emm.) (c).
4. *Pterygometopus* sp. undet. (r).
5. *Leperditia fabulites* (Con.) (c).

174 A^{14}. Hard, dark gray, granular limestone. 2 ft. 8 in.

1. Crinoid stems (r).
2. *Bumastus trentonensis* (Emm.) (r).

174 A^{15}. Hard, bluish-black limestone. 1 ft.

1. *Leperditia fabulites* (Con.) (r).

174 A^{16}. Hard, bluish-black limestone. 7 ft. 6 in.

1. *Pterygometopus* sp. undet. (r).
2. *Leperditia fabulites* (Con.) (c).

174 A^{17}. Dark, bluish-gray or nearly black, irregularly thin-bedded, knotty limestone. 15 ft.

1. *Streptelasma corniculum* H. (a).
2. *Actinostroma trentonensis* n. sp. (c).
3. Crinoid stems (c).
4. *Rhinidictya* sp. undet. (r).
5. *Schizocrania filosa* (H.) (r).
6. *Strophomena incurvata* (Shep.) (r).
7. *Rafinesquina alternata* (Emm.) (r).
8. *Plectambonites sericeus* (Sow.) (f).
9. *Orthis tricenaria* Con. (c).
10. *Dalmanella subæquata* (Con.) (c).
11. *Dalmanella testudinaria* (Dal.) (rr).
12. *Dinorthis pectinella* (Emm.) (c).
13. *Plectorthis plicatella* (Hall) (c).
14. *Rhynchotrema inæquivalvis* (Castel.) (a).
15. *Zygospira recurvirostris* (H.) (rr).
16. *Cyrtodonta canadensis* Bill. (a).
17. *Isotelus gigas* De Kay (r).
18. *Bumastus trentonensis* (Emm.) (r).
19. *Encrinurus trentonensis* Walc. (r).
20. *Pterygometopus callicephalus* (H.) (r).

The following additional species have been collected from a loose slab, probably from this bed:

1. *Nyctopora billingsi* Nich. (r).
2. *Actinostroma trentonensis* n. sp. (c).
3. *Parastrophia hemiplicata* (Hall) (r).

174 A^{19}. Dark, highly fossiliferous limestone in beds from three to six inches thick. 3 ft.

1. *Streptelasma corniculum* H. (rr).
2. *Plectambonites sericeus* (Sow.) (aa).
3. *Rhynchotrema inæquivalvis* (Castel.) (rr).
4. *Proetus brevimarginatus* n. sp. (rr).

174 A^{20}. Dark, fossiliferous limestone. 9 in.

1. *Strophomena incurvata* (Shep.) (r).
2. *Plectambonites sericeus* (Sow.) (aa).
3. *Dalmanella testudinaria* (Dal.) (r).
4. *Plectorthis plicatella* (Hall) (r).
5. *Parastrophia hemiplicata* (Hall) (c).
6. *Bucania punctifrons* Emm. (r).
7. *Isotelus gigas* De Kay (r).
8. *Calymene senaria* Con. (r).

174 A^{21}. Dark limestone, with some highly fossiliferous bands. 2 ft.

1. *Lingula* sp. undet. (r).
2. *Plectambonites sericeus* (Sow.) (aa).
3. *Dalmanella testudinaria* (Dal.) (c).
4. *Bucania punctifrons* Emm. (r).
5. *Proetus brevimarginatus* n. sp. (r).

174 A^{22}. Dark, fossiliferous limestone. 1 ft.

1. *Strophomena incurvata* (Shep.) (r).
2. *Rafinesquina alternata* (Emm.) (c).
3. *Dalmanella testudinaria* (Dal.) (aa).
4. *Plectorthis plicatella* (Hall) (r).
5. *Bucania punctifrons* Emm. (r).
6. *Hormotoma salteri* Ulr. (r).
7. *Isotelus gigas* De Kay (c).
8. *Proetus latimarginatus* n. sp. (f).

9. *Bronteus lunatus* Bill. (r).
10. *Calymene senaria* Con. (f).
11. *Pterygometopus callicephalus* (H.) (f).

174 A^{23}. Dark, fossiliferous limestone. 1 ft.

1. *Prasopora simulatrix* Ulr. (f).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (f).
4. *Dalmanella testudinaria* (Dal.) (aa).
5. *Plectorthis plicatella* (Hall) (r).
6. *Bucania punctifrons* Emm. (r).
7. *Hormotoma salteri* Ulr. (r).
8. *Conularia trentonensis* H. (r).
9. *Isotelus gigas* De Kay (f).
10. *Proetus latimarginatus* n. sp. (f).
11. *Calymene senaria* Con. (r).
12. *Pterygometopus callicephalus* (H.) (f).

174 A^{24}. Hard, bluish-black, fossiliferous limestone. 1 ft.

1. *Prasopora simulatrix* Ulr. (f).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (f).
4. *Dalmanella testudinaria* (Dal.) (c).
5. *Plectorthis plicatella* (Hall) (r).
6. *Orthoceras tenuistriatum* (H.) (c).
7. *Isotelus gigas* De Kay (f).
8. *Bathyurus extans* (Hall) (r).

9. *Conularia trentonensis* (Hall) (r).
10. *Harpina ottawensis* (Bill.) (r).
11. *Isotelus gigas* De Kay (c).
12. *Proetus latimarginatus* n. sp. (r).
13. *Pterygometopus callicephalus* (Hall) (r).

174 A^{26}. Dark, fossiliferous limestone. 9 in.

1. *Dalmanella testudinaria* (Dal.) (a).
2. *Plectorthis plicatella* (Hall) (f).
3. *Ctenodonta* sp. undet. (r).
4. *Protowarthia cancellata* (Hall) (r).
5. *Hormotoma salteri* Ulr. (r).
6. *Harpina ottawensis* (Bill.) (r).
7. *Isotelus gigas* De Kay (f).
8. *Bumastus trentonensis* (Emm.) (r).
9. *Proetus latimarginatus* n. sp. (r).
10. *Calymene senaria* Con. (r).

174 A^{27}. Dark, fossiliferous limestone. 1 ft. 2 in.

1. *Prasopora simulatrix* Ulr. (f).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (c).
4. *Plectambonites sericeus* (Sow.) (f).
5. *Dalmanella testudinaria* (Dal.) (c).
6. *Zygospira recurvirostris* Hall (r).
7. *Modiolopsis faba* (Con.) (f).
8. *Protowarthia cancellata* (Hall) (r).
9. *Tetranota bidorsata* (Hall) (r).
10. *Liospira micula* (Hall) (f).
11. *Orthoceras tenuistriatum* (Hall) (r).
12. *Trinucleus concentricus* (Eaton) (r).
13. *Isotelus gigas* De Kay (f).
14. *Bumastus trentonensis* (Emm.) (r).
15. *Calymene senaria* Con. (f).
16. *Pterygometopus callicephalus* (Hall) (f).

174 A^{28}. Dark limestone, sparsely fossiliferous. 8 in.

1. *Prasopora simulatrix* Ulr. (r).
2. *Lingula riciniformis* Hall (r).
3. *Rafinesquina alternata* (Emm.) (r).
4. *Plectambonites sericeus* (Sow.) (r).

5.	*Dalmanella testudinaria* (Dal.)	(r).
6.	*Conularia trentonensis* Hall	(r).
7.	*Bumastus trentonensis* (Emm.)	(r).

174 A^{29}. Sparsely fossiliferous, dark limestone. 2 ft.

1.	*Rafinesquina alternata* (Emm.)	(r).
2.	*Plectambonites sericeus* (Sow.)	(c).
3.	*Dalmanella testudinaria* (Dal.)	(a).
4.	*Parastrophia hemiplicata* (Hall)	(r).
5.	*Hormotoma salteri* Ulr.	(r).
6.	*Isotelus gigas* De Kay	(f).

174 A^{30}. Sparsely fossiliferous, dark limestone. 10 in.

1.	*Prasopora simulatrix* Ulr.	(f).
2.	*Orbiculoidea lamellosa* (Hall)	(r).
3.	*Strophomena incurvata* (Shep.)	(r).
4.	*Rafinesquina alternata* (Emm.)	(f).
5.	*Plectambonites sericeus* (Sow.)	(c).
6.	*Dalmanella testudinaria* (Dal.)	(c).
7.	*Zygospira recurvirostris* (Hall)	(r).
8.	*Ctenodonta* sp. undet.	(r).
9.	*Modiolopsis faba* (Con.)	(r).
10.	*Isotelus gigas* De Kay	(c).
11.	*Bumastus trentonensis* (Emm.)	(r).
12.	*Proetus latimarginatus* n. sp.	(f).

174 A^{31}. Dark, fossiliferous limestone. 1 ft. 8 in.

14. *Proetus brevimarginatus* n. sp. (r).
15. *Calymene senaria* Con. (r).
16. *Pterygometopus callicephalus* (Hall) (r).

174 A^{32}. Dark, fossiliferous limestone. 1 ft. 4 in.

1. *Lingula* sp. undet. (r).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (r).
4. *Plectambonites sericeus* (Sow.) (aa).
5. *Dalmanella testudinaria* (Dal.) (c).
6. *Zygospira recurvirostris* (Hall) (f).
7. *Ctenodonta* sp. undet. (r).
8. *Modiolopsis faba* (Con.) (r).
9. *Goniophora carinatus* (Hall) (r).
10. *Protowarthia cancellata* (Hall) (f).
11. *Bucania punctifrons* Emm. (r).
12. *Hormotoma salteri* Ulr. (c).
13. *Orthoceras* sp. undet. (f).
14. *Bumastus trentonensis* (Emm.) (r).
15. *Pterygometopus callicephalus* (Hall) (f).

174 A^{33}. Dark, fossiliferous limestone. 6 in.

1. *Prasopora simulatrix* Ulr. (r).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (r).
4. *Plectambonites sericeus* (Sow.) (aa).
5. *Dalmanella testudinaria* (Dal.) (c).
6. *Zygospira recurvirostris* (Hall) (f).
7. *Protowarthia cancellata* (Hall) (f).
8. *Liospira micula* (Hall) (r).
9. *Hormotoma salteri* Ulr. (c).
10. *Orthoceras* (r).
11. *Isotelus gigas* De Kay (f).
12. *Proetus latimarginatus* n. sp. (r).
13. *Calymene senaria* Con. (r).

174 A^{34}. Dark, fossiliferous limestone. 10 in.

1. *Plectambonites sericeus* (Sow.) (aa).
2. *Dalmanella testudinaria* (Dal.) (f).
3. *Zygospira recurvirostris* (Hall) (r).
4. *Ctenodonta* sp. undet. (r).

5. *Modiolopsis faba* (Con.) (r).
6. *Goniophora carinatus* (Hall) (r).
7. *Liospira micula* (Hall) (r).
8. *Hormotoma salteri* Ulr. (f).
9. *Orthoceras* sp. undet. (r).
10. *Isotelus gigas* De Kay (f).
11. *Proetus latimarginatus* n. sp. (f).
12. *Pterygometopus callicephalus* (Hall) (r).

174 A^{35}. Dark, fossiliferous limestone. 1 ft.

1. *Schizocrania filosa* (Hall) (r).
2. *Strophomena incurvata* (Shep.) (r).
3. *Rafinesquina alternata* (Emm.) (f).
4. *Plectambonites sericeus* (Sow.) (a).
5. *Dalmanella testudinaria* (Dal.) (a).
6. *Zygospira recurvirostris* (Hall) (r).
7. *Modiolopsis faba* (Con.) (f).
8. *Goniophora carinatus* (Hall) (r).
9. *Archinacella patelliformis* (Hall) (r).
10. *Liospira micula* (Hall) (r).
11. *Hormotoma salteri* Ulr. (c).
12. *Isotelus gigas* De Kay (r).
13. *Proetus latimarginatus* n. sp. (c).
14. *Pterygometopus callicephalus* (Hall) (r).

174 A^{36}. Dark, fossiliferous limestone. 1 ft. 4 in.

1. *Strophomena incurvata* (Shep.) (c).

15. *Isotelus gigas* De Kay (f).
16. *Proetus latimarginatus* n. sp. (f).
17. *Pterygometopus callicephalus* (Hall) (f).

174 A^{37}. Dark, fossiliferous limestone. 1 ft. 2 in.

1. *Lingula* sp. undet. (r).
2. *Rafinesquina alternata* (Emm.) (c).
3. *Plectambonites sericeus* (Sow.) (c).
4. *Dalmanella testudinaria* (Dal.) (c).
5. *Harpina ottawensis* (Bill.) (r).
6. *Calymene senaria* Con. (r).

174 A^{38}. Thin-bedded, fossiliferous, micaceous shale. 1 ft.

1. *Plectambonites sericeus* (Sow.) (r).
2. *Dalmanella testudinaria* (Dal.) (c).
3. *Plectorthis plicatella* (Hall) (r).

174 A^{39}. Thin-bedded, shaley limestone, with flakes of mica. 1 ft. 2 in.

1. *Plectambonites sericeus* (Sow.) (r).
2. *Dalmanella testudinaria* (Dal.) (c).
3. *Plectorthis plicatella* (Hall) (r).

174 A^{40}. Dark, fossiliferous limestone, with mica flakes. 1 ft.

1. *Strophomena incurvata* (Shep.) (r).
2. *Rafinesquina alternata* (Emm.) (c).
3. *Dalmanella testudinaria* (Dal.) (f).
4. *Plectorthis plicatella* (Hall) (f).
5. *Zygospira recurvirostris* (Hall) (r).
6. *Pterygometopus callicephalus* (Hall) (f).

174 A^{41}. Soft, decomposed, shaley limestone. 6 in.

1. *Dalmanella testudinaria* (Dal.) (c).
2. *Plectorthis plicatella* (Hall) (r).
3. *Proetus latimarginatus* n. sp. (r).
4. *Pterygometopus callicephalus* (Hall) (r).

174 A^{42}. Hard, dark, fossiliferous limestone. 6 in.

1. *Hindia parva* Ulr. (r).
2. *Prasopora simulatrix* Ulr. (r).
3. *Lingula* sp. undet. (r).
4. *Strophomena incurvata* (Shep.) (c).

5. *Rafinesquina alternata* (Emm.) (c).
6. *Dalmanella testudinaria* (Dal.) (c).
7. *Plectorthis plicatella* (Hall) (r).
8. *Zygospira recurvirostris* (Hall) (f).
9. *Ctenodonta* sp. undet. (f).
10. *Modiolopsis faba* (Con.) (r).
11. *Bucania punctifrons* Emm. (r).
12. *Liospira micula* (Hall) (r).
13. *Lophospira medialis* U. & S. (r).
14. *Hormotoma salteri* Ulr. (f).
15. *Orthoceras* sp. undet. (f).
16. *Trinucleus concentricus* (Eaton) (r).
17. *Isotelus gigas* De Kay (f).
18. *Bumastus trentonensis* (Emm.) (r).
19. *Proetus latimarginatus* n. sp. (f).
20. *Calymene senaria* Con. (r).
21. *Pterygometopus callicephalus* (Hall) (f).

174 A^{43}. Dark, sparsely fossiliferous limestone. 11 in.

1. *Lingula* sp. undet. (r).
2. *Strophomena incurvata* (Shep.) (r).
3. *Dalmanella testudinaria* (Dal.) (f).
4. *Plectorthis plicatella* (Hall) (f).
5. *Zygospira recurvirostris* (Hall) (f).
6. *Bumastus trentonensis* (Emm.) (f).

174 A^{44}. Dark, fossiliferous limestone. 1 ft.

15. *Tetranota bidorsata* (Hall) (r).
16. *Orthoceras* sp. undet. (r).
17. *Trinucleus concentricus* (Eaton) (r).
18. *Harpina ottawensis* (Bill.) (f).
19. *Isotelus gigas* De Kay (f).
20. *Bumastus trentonensis* (Emm.) (f).
21. *Proetus latimarginatus* n. sp. (f).
22. *Platymetopus trentonensis* (Hall) (r).
23. *Calymene senaria* Con. (r).
24. *Pterygometopus callicephalus* (Hall) (r).

174 A^{45}. Dark, fossiliferous limestone. . 1 ft. 1 in.

1. *Hindia parva* Ulr. (f).
2. *Lingula* sp. undet. (r).
3. *Strophomena incurvata* (Shep.) (r).
4. *Rafinesquina alternata* (Emm.) (r).
5. *Plectambonites sericeus* (Sow.) (r).
6. *Dalmanella testudinaria* (Dal.) (f).
7. *Plectorthis plicatella* (Hall) (f).
8. *Zygospira recurvirostris* (Hall) (r).
9. *Ctenodonta* sp. undet. (r).
10. *Cleidophorus neglectus* Hall (r).
11. *Protowarthia cancellata* (Hall) (f).
12. *Bucania punctifrons* Emm. (f).
13. *Eccyliomphalus trentonensis* (Hall) (r).
14. *Trinucleus concentricus* (Eaton) (r).
15. *Isotelus gigas* De Kay (r).
16. *Bumastus trentonensis* (Emm.) (f).
17. *Proetus latimarginatus* n. sp. (r).
18. *Cyphaspis trentonensis* n. sp. (r).
19. *Calymene senaria* Con. (f).
20. *Pterygometopus callicephalus* (Hall) (f).

174 A^{46}. Dark, fossiliferous limestone. 1 ft. 6 in.

1. *Strophomena incurvata* (Shep.) (f).
2. *Dalmanella testudinaria* (Dal.) (f).
3. *Plectorthis plicatella* (Hall) (f).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Ctenodonta* sp. undet. (f).
6. *Cyrtodonta* sp. undet. (r).

7. *Modiolopsis faba* Con. (f).
8. *Bucania punctifrons* Emm. (r).
9. *Protowarthia cancellata* (Hall) (f).
10. *Lophospira medialis* U. & S. (f).
11. *Conularia trentonensis* Hall (r).
12. *Trinucleus concentricus* (Eaton) (r).
13. *Isotelus gigas* De Kay (r).
14. *Bumastus trentonensis* (Emm.) (r).
15. *Proetus latimarginatus* n. sp. (r).
16. *Proetus brevimarginatus* n. sp. (r).
17. *Calymene senaria* Con. (r).
18. *Pterygometopus callicephalus* (Hall) (r).

174 A^{47}. Dark, fossiliferous limestone: 8 in.

1. *Prasopora simulatrix* Ulr. (f).
2. *Rhinidictya* sp. undet. (r).
3. *Strophomena incurvata* (Shep.) (r).
4. *Rafinesquina alternata* (Emm.) (r).
5. *Plectambonites sericeus* (Sow.) (c).
6. *Dalmanella testudinaria* (Dal.) (c).
7. *Platystrophia biforata* (Schl.) (r).
8. *Zygospira recurvirostris* (Hall) (f).
9. *Ctenodonta* sp. undet. (r).
10. *Modiolopsis faba* (Con.) (c).
11. *Orthodesma* sp. undet. (r).
12. *Bucania punctifrons* Emm. (f).
13. *Protowarthia cancellata* (Hall) (f).

174 A^{48}. Dark, fossiliferous limestone. 1 ft. 2 in.

1. *Rafinesquina alternata* (Emm.) (r).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (c).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Ctenodonta nasuta* (Hall) (r).
6. *Modiolopsis* sp. undet. (r).
7. *Bucania punctifrons* Emm. (r).
8. *Liospira micula* (Hall) (f).
9. *Lophospira medialis* U. & S. (f).
10. *Proetus latimarginatus* n. sp. (f).
11. *Calymene senaria* Con. (f).
12. *Pterygometopus callicephalus* (Hall) (f).

174 A^{49}. Dark, sparsely fossiliferous limestone. 6 in.

1. *Plectambonites sericeus* (Sow.) (r).
2. *Protowarthia cancellata* (Hall) (r).
3. *Pterygometopus callicephalus* (Hall) (r).

174 A^{50}. Dark, sparsely fossiliferous limestone. 7 in.

1. *Plectambonites sericeus* (Sow.) (c).
2. *Zygospira recurvirostris* (Hall) (r).
3. *Modiolopsis faba* (Con.) (r).

174 A^{51}. Dark, sparsely fossiliferous limestone. 1 ft.

1. *Rafinesquina alternata* (Emm.) (r).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (r).
4. *Lophospira medialis* U. & S. (r).
5. *Calymene senaria* Con. (r).
6. *Pterygometopus callicephalus* (Hall) (r).

174 A^{52}. Dark, fossiliferous limestone. 1 ft.

1. *Rafinesquina alternata* (Emm.) (c).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (c).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Ctenodonta* sp. undet. (r).
6. *Modiolopsis faba* Con. (r).

7. *Protowarthia cancellata* (Hall) (r).
8. *Liospira micula* (Hall) (r).
9. *Bumastus trentonensis* (Emm.) (c).
10. *Proetus latimarginatus* n. sp. (r).
11. *Proetus brevimarginatus* n. sp. (r).

174 A^{53}. Dark, fossiliferous limestone. 1 ft. 4 in.

1. *Rafinesquina alternata* (Emm.) (cc).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (c).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Modiolopsis* sp. undet. (r).
6. *Bumastus trentonensis* (Emm.) (r).
7. *Proetus latimarginatus* n. sp. (r).

174 A^{54}. Dark, fossiliferous limestone. 8 in.

1. *Plectambonites sericeus* (Sow.) (aa).
2. *Dalmanella testudinaria* (Dal.) (f).
3. *Modiolopsis faba* (Con.) (r).

174 A^{55}. Dark, fossiliferous limestone. 1 ft. 3 in.

1. *Plectambonites sericeus* (Sow.) (c).
2. *Dalmanella testudinaria* (Dal.) (f).
3. *Zygospira recurvirostris* (Hall) (f).
4. *Ctenodonta nasuta* (Hall) (r).
5. *Modiolopsis faba* (Con.) (r).
6. *Bucania punctifrons* Emm. (r).

5. *Protowarthia cancellata* (Hall) (f).
6. *Lophospira medialis* U. & S. (r).
7. *Orthoceras* sp. undet. (r).
8. *Proetus latimarginatus* n. sp. (r).
9. *Encrinurus trentonensis* Walc. (r).
10. *Pterygometopus callicephalus* (Hall) (f).

174 A^{57}. Dark, fossiliferous limestone. 1 ft.

1. *Streptelasma corniculum* Hall (r).
2. *Rhinidictya* sp. undet. (r).
3. *Strophomena incurvata* (Shep.) (r).
4. *Rafinesquina alternata* (Emm.) (r).
5. *Plectambonites sericeus* (Sow.) (c).
6. *Dalmanella testudinaria* (Dal.) (f).
7. *Zygospira recurvirostris* (Hall) (c).
8. *Ctenodonta* sp. undet. (r).
9. *Bucania punctifrons* Emm. (f).
10. *Protowarthia cancellata* (Hall) (c).
11. *Holopea* sp. undet. (r).
12. *Orthoceras* sp. undet. (f).
13. *Isotelus gigas* De Kay (r).
14. *Proetus latimarginatus* n. sp. (f).
15. *Platymetopus trentonensis* (Hall) (r).
16. *Encrinurus trentonensis* Walc. (r).
17. *Calymene senaria* Con. (f).
18. *Pterygometopus callicephalus* (Hall) (f).

174 A^{58}. Dark, fossiliferous limestone. 1 ft.

1. *Rafinesquina alternata* (Emm.) (r).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (c).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Bucania punctifrons* Emm. (r).
6. *Protowarthia cancellata* (Hall) (r).
7. *Lophospira medialis* U. & S. (r).
8. *Orthoceras* sp. undet. (r).
9. *Proetus latimarginatus* n. sp. (f).
10. *Encrinurus trentonensis* Walc. (r).
11. *Calymene senaria* Con. (r).
12. *Pterygometopus callicephalus* (Hall) (r).

174 A^{59}. Dark, fossiliferous limestone. 11 in.

1. *Streptelasma corniculum* Hall (r).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (f).
4. *Zygospira recurvirostris* (Hall) (f).
5. *Lophospira medialis* U. & S. (r).

174 A^{60}. Dark, fossiliferous limestone. 11 in.

1. *Hindia parva* Ulr. (f).
2. *Rafinesquina alternata* (Emm.) (r).
3. *Plectambonites sericeus* (Sow.) (c).
4. *Dalmanella testudinaria* (Dal.) (f.)
5. *Zygospira recurvirostris* (Hall) (f).
6. *Bucania punctifrons* Emm. (r).
7. *Protowarthia cancellata* (Hall) (r).
8. *Orthoceras* sp. undet. (r).
9. *Proetus latimarginatus* n. sp. (f).
10. *Calymene senaria* Con. (r).
11. *Pterygometopus callicephalus* (Hall) (f).

174 A^{61}. Dark, fossiliferous limestone. 1 ft.

1. *Rafinesquina alternata* (Emm.) (r).
2. *Plectambonites sericeus* (Sow.) (c).
3. *Dalmanella testudinaria* (Dal.) (f).
4. *Zygospira recurvirostris* (Hall) (c).
5. *Cleidophorus* sp. undet. (r).
6. *Modiolopsis faba* (Con.) (r).

gnized in the Jacksonburg section, the species occurring in each
being recorded in the column especially reserved for that bed.
amination of the table shows that the first sixteen beds, com-
ing a thickness of strata of fifty-eight feet and four inches, con-
fauna which is quite distinct from the faunas of the succeeding
The most characteristic species of this lower fauna are *Dal-
ella subæquata* and *Leperditia fabulites*, and the beds containing
ay be considered as representing the Black River limestone of the
York section. The beds from numbers 17 to 61, inclusive, repre-
the Trenton limestone proper, and although there are several
rdinate faunal zones recognizable, the beds, as a whole, are es-
lly characterized throughout by *Plectambonites sericeus, Dal-
ella testudinaria, Zygospira recurvirostris* and *Pterygometopus
cephalus*. Only eight species pass from the lower horizon to the
r, and of these only three, *Rafinesquina alternata, Isotelus gigas
Bumastus trentonensis*, are conspicuous forms in both the lower
the upper faunas. The remaining five species are either com-
tively rare, or, if normally members of the lower fauna, as *Dal-
ella subæquata*, occur, also, only in the base of the beds carrying
upper fauna: or they are initiated near the summit of the lower
and become more abundant above.

ithin the Trenton limestone proper a basal zone, including beds
bers 17 to 19, inclusive, is especially characterized by the species
otelasma corniculum, Actinostroma trentonensis, Orthis tricenaria,
rthis pectinella* and *Rhynchotrema inæquivalvis*. Just above this
zone is another, with rather indefinite limits, which bears *Paras-
hia hemiplicata*. The lower beds of the Trenton limestone proper
characterized by the special abundance of *Plectambonites seri-
and the rarity of *Dalmanella testudinaria*, but higher up the
ive abundance of these two species is reversed. Dalmanella usually
g the most conspicuous species in the faunas. In the higher beds
Pelecypod, Gastropod and Trilobite species become more con-
ious. In a general way the faunas of the section may be sepa-
l into three zones—the Black River horizon, the lower Trenton
the upper Trenton—the two lower zones being more sharply
rated than the two upper ones.

e more or less isolated Trenton faunas which have been collected
other localities in the State can all be placed, in a general way,
ne or the other of these three zones recognized in the Jackson-

burg section, although there must of necessity be more or less mingling of the species from other localities, because the material has in nearly all cases been collected from loose blocks of limestone on the surface. In the discussion of the Trenton faunas from elsewhere in the State they will be arranged geographically, those from the northernmost localities being first described, followed in order by the others, as nearly as possible, towards the south.

Locality 79 A.—The northernmost locality from which a good Trenton fauna has been secured in New Jersey is about seven-eighths of a mile a little west of north from Beaver Run, west of Hamburg.* At this locality the following species of fossils were collected:

1. *Hindia parva* Ulr.
2. *Prasopora simulatrix* Ulr.
3. *Monotrypa globosa* n. sp.
4. *Callopora* sp. undet.
5. *Rhinidictya* sp. undet.
6. *Phylloporina fenestrata* (Hall).
7. *Crania* sp. undet.
8. *Schizocrania filosa* (Hall).
9. *Lingula progne* Bill.?
10. *Rafinesquina alternata* (Emm.).
11. *Plectambonites sericeus* (Sow.).
12. *Strophomena incurvata* (Shep.).
13. *Orthis tricenaria* Con.
14. *Plectorthis plicatella* Hall.
15. *Platystrophia biforata* (Schl.).
16. *Dalmanella testudinaria* (Dal.).

The fossils secured from this locality were all collected from loose blocks of limestone, and doubtless came originally from several different beds. No representatives of the Black River fauna occur, however, although both lower and upper Trenton species, such as *Orthis tricenaria* and *Platystrophia biforata*, are recorded. The locality is a promising one—the fossils being abundant and well preserved—and a careful study of the section, similar to that made at Jacksonburg, would undoubtedly shed light on the faunal succession in the New Jersey Trenton limestone.

Locality 79 B.—The next locality lies just a quarter of a mile east of Beaver Run, on the western side of the fault line, which is there present.* The following species have been recognized:

1. *Prasopora simulatrix* Ulr.
2. *Plectambonites sericeus* (Sow.).
3. *Strophomena incurvata* (Shep.).
4. *Dinorthis pectinella* (Emm.).
5. *Bumastus trentonensis* (Emm.).
6. *Calymene senaria* Con.

This fauna undoubtedly represents the lower Trenton horizon. The presence of *Dinorthis pectinella* and the abundance of *Plectambonites sericea*, with the absence of *Dalmanella testudinaria*, are its distinctive lower Trenton features.

Locality 75 A.—Lying about three-fourths of a mile nearly due east from Branchville† is one of the most interesting fossiliferous Trenton localities in the State, because, in the Hudson River shales, a short distance above the limestone, an interesting graptolite fauna occurs. The Trenton fossils which have been collected at this locality are as follows:

1. *Streptelasma corniculum* Hall.
2. *Nyctopora billingsi* Nich.
3. *Prasopora simulatrix* Ulr.
4. *Monotrypa* sp. undet.
5. *Callopora* sp. undet.
6. *Orbiculoidea lamellosa* (Hall).
7. *Orbiculoidea?* sp. undet.
8. *Crania* sp. undet.
9. *Rafinesquina alternata* (Emm.).
10. *Plectambonites sericeus* (Sow.).

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*See Map No. 15, indicated in the previous footnote.

†See Map No. 7, p. 52, Ann. Rep. State Geol. for 1900.

11. *Strophomena incurvata* (Shep.).
12. *Dinorthis pectinella* (Emm.).
13. *Platystrophia biforata* (Schl.).
14. *Dalmanella testudinaria* (Dal.).
15. *Dalmanella subæquata* (Con.).
16. *Parastrophia hemiplicata* (Hall).
17. *Rhynchotrema inæquivalvis* (Castel.).
18. *Cyclonema montrealensis* Bill.
19. *Isotelus gigas* De Kay.
20. *Calymene senaria* Con.

With the single exception of *Platystrophia biforata*, which has been found *in situ* elsewhere only near the top of the Trenton limestone, in the Jacksonburg secton, this entire fauna is strongly lower Trenton in aspect. The limestone at this locality, from which the fossils were collected, is more nearly *in situ* than in most of the Trenton localities studied, and there is but little doubt that the species all occurred together, in which case it must be assumed that *Platystrophia biforata* does, at times, but not often, occur in the lower Trenton beds. The fossils were collected from the higher beds exposed at the locality, the lower strata being highly conglomeritic with pebbles derived from the subjacent Kittatinny limestone. The Hudson River slates outcrop only a short distance above the limestone stratum bearing the fossils, and it seems probable that the shale deposition began somewhat earlier than usual at this locality.

Locality 114 A.—The next locality is about one-half mile from Swartzwood station, on the west side of the road to Swartzwood.* At

10. *Isotelus gigas* De Kay.
11. *Bumastus trentonensis* (Emm.).
12. *Calymene senaria* Con.
13. *Pterygometopus callicephalus* (Hall).
14. *Leperditia fabulites* (Con.).

The fossils from this locality are practically *in situ*. The presence of such species as *Streptelasma corniculum*, *Orthis tricenaria* and *Pterygometopus callicephalus*, associated with *Dalmanella subæquata*, *Helicotoma* sp. and *Leperditia fabulites*, indicates the position of the beds to be at the top of the Black River horizon or at the very base of the lower Trenton. *Receptaculites occidentalis* is an interesting species which was not found in the Jacksonburg section, but which occurs frequently in New Jersey, and seems to mark a faunal zone at the very summit of the Black River horizon.

Locality 135 A.—This locality lies about one-fourth of a mile south of the slate quarry at Newton.* The fossils were collected from loose masses of limestone on a barren knoll in the midst of the cultivated fields, and the following species have been identified:

1. *Prasopora simulatrix* Ulr.
2. *Rhinidictya* sp. undet.
3. *Plectambonites sericeus* (Sow.).
4. *Plectorthis plicatella* (Hall).
5. *Dalmanella testudinaria* (Dal.).
6. *Parastrophia hemiplicata* (Hall).
7. *Zygospira recurvirostris* (Hall).
8. *Tetranota bidorsata* (Hall).
9. *Bumastus trentonensis* (Emm.).
10. *Calymene senaria* Con.
11. *Pterygometopus callicephalus* (Hall).

This fauna indicates the middle portion of the Trenton limestone proper. The extreme basal Trenton species, such as *Streptelasma corniculum*, *Orthis tricenaria*, *Dinorthis pectinella* and *Rhynchotrema inæquivalvis*, are all absent, but *Parastrophia hemiplicata*, which characterizes the zone next above, is one of the common species, and is associated with *Tetranota bidorsata*, which occurs somewhat higher in the Jacksonburg section. From the nature of the locality fossils from more than one bed in the formation have become mingled in the collection.

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* **Near locality marked 14, Map No. 17, p. 75, loc. cit.**

Locality 136 B.—One of the best localities in the State to collect from the lower Trenton horizon, is just at the north end of Drake's pond, one mile southeast of Newton. The following species have been identified from this locality:

1. *Nyctopora billingsi* Nich.
2. *Prasopora simulatrix* Ulr.
3. *Rhinidictya* sp. undet.
4. *Lingulasma galenænsis* U. & S.
5. *Rafinesquina alternata* (Emm.).
6. *Plectambonites sericeus* (Sow.).
7. *Strophomene incurvata* (Shep.).
8. *Orthis tricenaria* Con.
9. *Dinorthis pectinella* (Emm.).
10. *Platystrophia biforata* (Schl.).
11. *Dalmanella testudinaria* (Dal.).
12. *Parastrophia hemiplicata* (Hall).
13. *Cyrtodonta billingsi* Ulr.
14. *Isotelus gigas* De Kay.
15. *Bumastus trentonensis* (Emm.).
16. *Platymetopus trentonensis* (Hall).
17. *Calymene senaria* Con.
18. *Ceraurus pleurexanthemus* Green.
19. *Pterygometopus callicephalus* (Hall).

This group of species is strictly confined to the lower Trenton horizon, both the *Orthis tricenaria* and the *Parastrophia hemiplicata* zones being represented. None of the higher Trenton forms are present.

5. *Camarella inornata* n. sp.
6. *Rhynchotrema inæquivalvis* (Castel.).
7. *Rhinidictya* sp. undet.
8. *Ctenodonta nasuta* (Hall).
9. *Cyrtodonta?* sp. undet.
10. *Hormotoma salteri* Ulr.
11. *Orthoceras* sp. undet.
12. *Bumastus trentonensis* (Emm.).
13. *Arges tuberculatus* n. sp.
14. *Calymene senaria* Con.
15. *Leperditia fabulites* (Con.).
16. *Leperditella ornata.* n. sp.
17. *Eurychilina oculifera* n. sp.
18. *Eurychilina jerseyensis* n. sp.
19. *Beyrichia* sp. undet.

Leperditia fabulites is by far the most abundant species in this fauna, a characteristic which stamps it as belonging to the Black River horizon; but the presence of such species as *Streptelasma corniculum* and *Rhynchotrema inæquivalvis* suggests that it occurs near the summit of the beds referable to that horizon.

From the higher beds at the same locality the following fauna was secured:

1. *Prasopora simulatrix* Ulr.
2. *Monotrypa* sp. undet.
3. *Rhinidictya* sp. undet.
4. *Callopora* sp. undet.
5. *Crania* sp. undet.
6. *Rafinesquina alternata* (Emm.).
7. *Plectambonites sericeus* (Sow.).
8. *Strophomena incurvata* (Shep.).
9. *Platystrophia biforata* (Schl.).
10. *Dalmanella testudinaria* (Dal.).
11. *Scenidium anthonensis* Sard.
12. *Parastrophia hemiplicata* (Hall).
13. *Zygospira recurvirostris* (Hall).
14. *Orthoceras* sp. undet.
15. *Isotelus gigas* De Kay.
16. *Bumastus trentonensis* (Emm.).
17. *Proetus latimarginatus* n. sp.

18. *Platymetopus trentonensis* (Hall).
19. *Encrinurus trentonensis* Walc.
20. *Calymene senaria* Con.
21. *Ceraurus pleurexanthemus* Green.
22. *Pterygometopus callicephalus* (Hall).

This fauna suggests a lower Trenton horizon, but is not from the lowest, or *Orthis tricenaria*, zone, as none of the species characteristic of that zone have been found, but it is rather from the next succeeding, *Parastrophia hemiplicata*, zone. The rarity of the pelecypod and gastropod elements in the fauna exclude it from the upper Trenton.

Locality 158 A.—Along the same line of outcrop as the last locality, and at a point about one and one-fourth miles in a southwesterly direction,* another collection was made from the Trenton limestone, and the following species have been identified:

1. *Streptelasma corniculum* Hall.
2. *Prasopora simulatrix* Ulr.
3. *Monotrypa* sp. undet.
4. *Callopora* sp. undet.
5. *Rafinesquina alternata* (Emm.).
6. *Plectambonites sericeus* (Sow.).
7. *Strophomena incurvata* (Shep.).
8. *Plectorthis plicatella* (Hall).
9. *Dalmanella testudinaria* (Dal.).
10. *Parastrophia hemiplicata* (Hall).
11. *Zygospira recurvirostris* (Hall).
12. *Bumastus trentonensis* (Emm.).
13. *Platymetopus trentonensis* (Hall).

4. *Strophomena incurvata* (Shep.).
5. *Plectorthis plicatella* (Hall).
6. *Platystrophia biforata* (Schl.).
7. *Dalmanella testudinaria* (Dal.).
8. *Zygospira recurvirostris* (Hall).
9. *Hormotoma salteri* Ulr.
10. *Bumastus trentonensis* (Emm.).
11. *Bronteus lunatus* Bill.

This fauna seems to represent nearly the same horizon as the last, but in the absence of *Parastrophia hemiplicata*, may, perhaps, be considered as having come from a little higher up in the formation.

Locality 157 A.—This locality is in the roadside just above Mr. Wittingham's house, three miles southwest of Newton.* The Trenton formation at this point is a highly calcareous shale, like that used in the State for the manufacture of Portland cement. The species identified from here are as follows:

1. *Prasopora simulatrix* Ulr.
2. *Rafinesquina alternata* (Emm.).
3. *Plectambonites sericeus* (Sow.).
4. *Strophomena incurvata* (Shep.).
5. *Dalmanella testudinaria* (Dal.).
6. *Zygospira recurvirostris* (Hall).
7. *Isotelus gigas* De Kay.
8. *Bumastus trentonensis* (Emm.).
9. *Proetus latimarginatus* n. sp.
10. *Pterygometopus callicephalus* (Hall).

This fauna was collected from beds *in situ*, and represents a horizon higher in the formation than the *Parastrophia hemiplicata* zone. It may probably be safely placed in the middle portion of the Trenton limestone as represented in the Jacksonburg section.

Locality 156 A.—This locality is on the same line of outcrop as the last, and about one mile to the southwest.† The following species have been identified:

1. *Receptaculites occidentalis* Salter.
2. *Streptelasma corniculum* Hall.
3. *Rhinidictya* sp. undet.
4. *Lingula* sp. undet.
5. *Rafinesquina alternata* (Emm.).

*** See locality 15, Map No. 18, p. 80, loc. cit.**

† Locality A, Map No. 18, p. 80, loc. cit.

6. *Plectambonites sericeus* (Sow.).
7. *Strophomena incurvata* (Shep.).
8. *Dalmanella testudinaria* (Dal.).
9. *Dalmanella subæquata* (Con.).
10. *Rhynchotrema inæquivalvis* (Castel.)
11. *Oxydiscus* sp. undet.
12. *Helicotoma* sp. undet.
13. *Camaroceras proteiformis* (Hall).
14. *Isotelus gigas* De Kay.
15. *Bumastus trentonensis* (Emm.).
16. *Bumastus elongatus* n. sp.
17. *Platymetopus trentonensis* (Hall).
18. *Calymene senaria* Con.
19. *Leperditia fabulites* (Con.).

The association of species in this list indicates a mingling of the Black River forms, such as *Leperditia fabulites* and *Dalmanella subæquata*, with those from the lower zone of the Trenton, as *Streptelasma corniculum* and *Rhynchotrema inæquivalvis*. The specimens were all collected from loose blocks of limestone, which were doubtless originally derived from the upper Black River and the lower Trenton beds.

Locality 153 A.—This locality lies about two miles southwest of Stillwater and about one-quarter of a mile from Mud pond.* The following list of species were collected:

1. *Receptaculites occidentalis* Salter.
2. *Streptelasma corniculum* Hall.
3. *Nyctopora billingsi* Nich.
4. *Romingeria? trentonensis* n. sp.

16. *Bumastus trentonensis* (Emm.).
17. *Pterygometopus callicephalus* (Hall).
18. *Leperditia fabulites* (Con.).

The strata which have afforded the species recorded in the above list are undoubtedly the higher Black River and the lower Trenton beds, all of the species identified, except such as occur throughout the Trenton limestone, being characteristic of this horizon.

Locality 153 B.—This locality lies one mile southwest of the last, on the same line of outcrop,* and has furnished the following species, the horizon represented being the same as the last:

1. *Receptaculites occidentalis* Salter.
2. *Streptelasma corniculum* Hall.
3. *Romingeria? trentonensis* n. sp.
4. *Actinostroma trentonensis* n. sp.
5. *Prasopora simulatrix* Ulr.
6. *Lingula* sp. undet.
7. *Plectambonites sericeus* (Sow.).
8. *Dalmanella testudinaria* (Dal.).
9. *Dalmanella subæquata* (Con.).
10. *Rhynchotrema inæquivalvis* (Castel.).
11. *Hormotoma salteri* Ulr.
12. *Bumastus trentonensis* (Emm.).
13. *Leperditia fabulites* (Con.).

Locality 192 A.—This locality is near Hainesburg, on the hill just east of the station,† and from it the following species have been identified:

1. *Receptaculites occidentalis* Salter.
2. *Streptelasma corniculum* Hall.
3. *Romingeria? trentonensis* n. sp.
4. *Rafinesquina alternata* (Emm.).
5. *Dinorthis pectinella* (Emm.).
6. *Dalmanella subæquata* (Con.).
7. *Camarella inornata* n. sp.
8. *Rhynchotrema inæquivalvis* (Castel.)
9. *Cyrtodonta canadensis* Bill.?
10. *Hormotoma salteri* Ulr.
11. *Bumastus trentonensis* (Emm.).
12. *Leperditia fabulites* (Con.).

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* **Locality C, Map No. 10, p. 60, loc. cit.**

† **Locality 7, Map No. 12, p. 64, loc. cit.**

This list is, for the most part, of Black River species, but with a few forms from the lowest Trenton. The horizon of the beds is upper Black River and basal Trenton.

Locality 243 A.—This locality is in a small railway cut and quarry by the side of the Pennsylvania railroad, three-fourths of a mile north of the station at Belvidere.* At this point there is only a small exposure of the limestone and the fossils are very poorly preserved, only the following three species being identified:

1. *Actinostroma trentonensis* n. sp.
2. *Orthis tricenaria* Con.
3. *Bumastus trentonensis* (Emm.).

The horizon indicated is the basal portion of the Trenton limestone proper.

Locality 244 A.—Another locality near Belvidere, which has furnished a few fossils, is a highly calcareous shale or slate, outcropping along the Pequest river, about one and one-quarter miles northwest of the town.† The following species of fossils have been identified:

1. *Prasopora simulatrix* Ulr.
2. *Rafinesquina alternata* (Emm.).
3. *Plectambonites sericeus* (Sow.).
4. *Dalmanella testudinaria* (Dal.).
5. *Bumastus trentonensis* (Emm.).

None of the species recorded from here are distinctive enough to characterize any particular horizon, further than to show it to be higher than the Black river. The most abundant species in the fauna is *Plectambonites sericeus*; *Dalmanella testudinaria* being comparatively rare, a fact which would indicate the horizon to be in the lower nearly all indicate a lower Trenton or upper Black River horizon, and it may doubtless be stated with safety that the heavier beds of limestone in the formation occupy this horizon. In no other locality in the State, aside from Jacksonburg, so far as has been observed, have the higher beds of the formation been represented by limestones. In most cases these beds seem to be calcareous shales, which rarely outcrop on the surface, and which grade imperceptibly from the limestones below into the typical Hudson river slates above. Sometimes, as on the Pequest river near Belvidere, the deposition of the calcareous shales seems to have begun earlier than usual, even as early as the lower Trenton horizon.

The numerous field observations by Dr. Kümmel indicate that the average thickness of the formation as a whole, from the contact with the Kittatinny limestone below to the transition into the typical Hudson River slates, varies from 135 to 150 feet in Sussex county, but increases to 300 feet or more at the Delaware river; the relative thickness of the limestones below and the calcareous shales above is, however, probably quite variable—in some localities, as at Jacksonburg, the limestones extending through nearly the entire thickness of the formation, and again, being very thin, as in the neighborhood of Belvidere.

HUDSON RIVER SLATES.

The Hudson River slates constitute the surface formation over a large portion of the Kittatinny valley and occur, also, in some of the outlying paleozoic areas surrounded by the crystalline rocks. The formation rests conformably upon the Trenton limestone and is not sharply separated from it, there being a gradual gradation from the limestone of the lower formation, through calcareous shales, to the typical slates and arenaceous beds of the Hudson River formation. Because of the great amount of folding and faulting in the region the thickness of the formation has not been determined, but it may probably be safely stated to be several thousands of feet.

The name Hudson River is here used strictly as a formation name, these beds evidently being continuous with the great mass of contorted slates along the Hudson river in New York State, to which this name was first applied. The transition from the calcareous to the clay and sand sedimentation seems to have taken place earlier in the ancient Ordovician ocean, towards its eastern shore, in the region which is now Eastern New York and Northwestern New Jersey, and probably extending southwestwardly along the Appalachians, than at Trenton Falls, in Central New York, where the Trenton limestone was first described. The time of the beginning of deposition of the Hudson River slates was previous to the close of the deposition of the typical Trenton limestone, so that the deposition of the lower portion of the Hudson River formation was contemporaneous with the Trenton limestone beds further west. The evidence in New Jersey of this relationship between the Hudson River and the Trenton formations is—*first,* the much less thickness of the Trenton limestone in New Jersey, where, exclusive of the lower beds of Black River age, it is less than one hundred feet, while at Trenton Falls, New York, it is two hundred and seventy feet and at some other localities very much more; and *second,* because the fossil faunas in the Trenton limestone of New Jersey, for the most part, represent only the lowest life zones of the formation.

Although the age of the base of the Hudson River formation can be determined with some degree of certainty by the faunas of the subjacent Trenton limestone, the age of the top of the formation in New Jersey has not been determined, because of the extreme rarity of organic remains in the formation. The formation may be the time equivalent, not only of a portion of the Trenton, but also of the Utica and the Lorrain formations of the New York series.

In the typical exposures of the Trenton limestone at Trenton Falls, New York, 270 feet have been recognized by Prosser and Cummings* and 268 feet by White,† but neither the bottom nor the top of the formation is exposed at this locality. Dana‡ gives the thickness of the Trenton limestone at Montreal as 600 feet and west of Lake Ontario as nearly 1,000 feet.

If we tabluate the thickness of these several Ordovician formations as they occur in their more typical New York and Canadian exposures, comparing them with the New Jersey section, some such relations as are exhibited in the accompanying table may be shown. The thickness of the New York and Canadian formations used are somewhat arbitrarily chosen, but in all cases they have been under rather than overestimated. Winchell and Ulrich[*] have used greater thicknesses for the same formations in a comparison with more western localities, the Trenton being estimated as 450 feet, the Utica 460 feet and the Lorrain 825 feet.

New York and Canada.	New Jersey.
Lorrain, 600.	HUDSON RIVER SLATE.
Utica, 400.	
Black River and Trenton, 300.	Norman's Kill * * * * Fauna. Black River and Trenton, 185.

The organic remains in the Hudson River formation are exceedingly rare, only three fossil localities having been observed in the State.

Locality 44 A.—This locality is in the flagstone quarry within the limits of the borough of Sussex. At this place the strata are nearly vertical in position and the fossils occur only in a thin bed but a few inches in thickness, which is exposed near the front of the quarry. This bed is a very calcareous sandstone, and is crowded with many specimens of a small variety of *Plectambonites sericeus*, with a few other species rarely represented. The fossils may be most easily detected in the weathered portions of the rock. The species which have been identified are as follows:

1. *Cornulites* sp. undet.
2. *Plectambonites sericeus* (Sow).
3. *Plectorthis plicatella* (Hall).
4. *Dalmanella testudinaria* (Dal.).

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[*] Geol. and Nat. Hist. Surv. Minn., vol. III., pt. II., Paleontology, p. lxxxix.

None of these species has a very definite, stratigraphic value, as all of them have a long range in the Ordovician strata, so that they indicate nothing beyond the Ordovician age of the stratum in which they occur.

Locality 75 B.—This locality is on the hillside, a short distance above the Trenton limestone, Locality 75 A, three-fourths of a mile east of Branchville. The fossils were collected in a small quarry opening in the slate, and have all been replaced by pyrite, their condition of preservation being far from satisfactory. The species recognized are as follows:[*]

1. *Diplograptus foliaceus* (Murch.).
2. *Diplograptus angustifolius* (Hall).
3. *Lasiograptus mucronatus* (Hall).
4. *Corynoides calycularis* Nich.
5. *Dalmanella testudinaria* (Dal.).

All of these graptolite species occur in the Norman's Kill shale, near Albany, New York, and all except *Diplograptus foliacens,* which has a wide range in the Ordovician formations, are among the characteristic species of the Norman's Kill fauna, and are not known to occur at any other horizon. The occurrence of species of this graptolite fauna in New Jersey is of interest, because its exact geologic horizon in New York has been a question of much discussion. Different authors have placed the Norman's Kill shale in the Lorrain, the Utica and the Trenton periods of the Ordovician. An able discussion of the whole problem connected with the Norman's Kill fauna, with a historical review of all earlier opinions, has been presented by Dr.

strophia hemiplicata zone (see page 39), near the base of the Trenton limestone. The sequence from the Trenton limestone to the Hudson River slates at this locality is normal for New Jersey, and there is no dislocation of the strata between the two exposures. Although no Trenton fauna has been found above the graptolite beds, their position, as indicated by their relationship with the *Parastrophia hemiplicata* beds below, would seem to be equivalent to about the middle portion of the typical Trenton limestone of Central New York, or even to a position below the middle.

Locality 348 A.—This locality is near Jutland, in the large outlying area of Paleozoic rocks, with the town of Clinton near its centre, and which lies between the Pre-cambrian crystalline rocks on the north and the Triassic sandstone on the south. The fossils were collected in the first railroad cut east of Jutland, on the Lehigh Valley railroad, about 340 yards east of Jutland station and 92 yards from the contact of the Triassic sandstone with the Hudson River beds. The geologic structure of the neighboring region is very complex, and the position of the fossil-bearing bed in the formation, as a whole, cannot be determined. The fossils collected have been identified as follows, all of them being graptolites:

1. *Climacograptus phyllophorus* Gurley.
2. *Dicranograptus ramosus* (Hall).
3. *Cœnograptus gracilis* (Hall).
4. *Reteograptus geinitzianus* Hall.

Of these species all but *Dicranograptus ramosus,* which sometimes occurs in the Utica shale, are characteristic of the Norman's Kill fauna, and the bed bearing the fauna undoubtedly belongs near the base of the Hudson River formation.

CHAPTER IV.

FORMATIONS OF SILURIAN AGE.

SHAWANGUNK—GREEN POND CONGLOMERATE.

The formation next above the Hudson River slates is best exhibited in the Kittatinny mountain, where it forms the crest of the ridge, dipping away to the northwest. The northward extension of this mountain in New York is known as the Shawangunk mountain, and in 1840 this formation was named the Shawangunk grit by Mather.[*] The name Oneida was applied later by Vanuxem,[†] in 1842, and has been the usual designation of the formation in New Jersey, but Mather's name has priority, and it seems best to retain it.

The formation consists of beds of coarse quartz conglomerate, the pebbles usually being white or yellowish in color, with a gray or red matrix. Nowhere in New Jersey has the contact between this formation and the subjacent Hudson River beds been observed, but in the New York, Lake Erie and Western railroad cut west of Otisville,[‡] in New York, the contact is well exposed, and the higher formation is seen to rest unconformably upon the lower. The thickness of the formation in the Kittatinny mountain has been estimated by Dr. Kümmel to be 1,500 to 1,600 feet.

In the Green Pond mountain region a conglomerate very similar to that of the Kittatinny mountain forms the crests of Green Pond, soft, red, arenaceous, more or less shaley, unfossiliferous beds, and in both regions the first fossil fauna, which appears in higher beds lying in a perfectly conformable series with the conglomerate beds, is identical.

The western side of the Green Pond paleozoic area is cut off by profound faults along its entire extent, and it is altogether probable that, at the time of its deposition, the Green Pond conglomerate was continuous with the Shawangunk conglomerate of the Kittatinny mountain, and that it has been removed by erosion from the intervening Highlands and the Kittatinny valley.

MEDINA—LONGWOOD SANDSTONE.

In the Delaware valley this formation covers a large portion of the northwestern slope of the Kittatinny mountain, and doubtless occupies the greater portion of the valley lying west of the Wallpack ridge, although the surface rock is deeply drift-covered in the valley. The formation is a soft sandstone, which is often somewhat shaley and has a deep red color. It is absolutely barren of organic remains. It is impossible to determine its thickness accurately, owing to the indefiniteness in the field of its upper limits and numerous low folds and small faults which affect it. At the Delaware Water Gap 1,645 feet is given by the Pennsylvania Survey* as the thickness of the beds which we class as Medina, with 740 feet additional not exposed, but probably belonging here—a total of 2,385 feet. An estimate by Dr. Kümmel, based on its dip and width of outcrop near Poxino island, gave 2,305 feet.

This formation has always been referred to the Medina sandstone of the New York series, and although it cannot be considered as being strictly equivalent to the typical Medina of Western New York, the name may be retained for the present or until the relationship between this formation in the Appalachian province with that in the interior is better understood.

In the Green Pond mountain region Darton† has called the formation overlying the Green Pond conglomerate, which is exactly similar to the upper part of the Medina of the Delaware valley in its lithologic characters, the Longwood red shales, and it is possible that, with future studies upon the relationship between this formation in New Jersey with the typical Medina, it may be found advisable to use the name Longwood to include the beds of both the Green Pond and the Delaware valley regions, as they were probably continuous at the time of deposition over the crystalline highlands and the Kittatinny valley. In the Green Pond region Dr. Kümmel has estimated the thickness of the Longwood beds to be over 200 feet.

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* Second Penn. Geol. Surv., Rep. G. 6, p. 340.

† Bull. Geol. Soc. Am., vol. V., p. 382 (1894).

THE NEARPASS SECTION.

The formations lying above the Medina sandstone in New Jersey, with the exception of the Devonian formations younger than the Onondaga limestone and the Newfoundland grit, have their most typical development in the Wallpack ridge. This ridge lies between the Kittatinny mountain and the Delaware river, extending in a northeast-southwest direction from the New York State line to the Wallpack bend in the Delaware river at Flatbrookville. At the north, just north of the State line, the ridge is transected by the Clove brook, which drains the northern half of the valley between the Wallpack ridge and the Kittatinny mountain, and which empties into the Neversink river at Tri-States, New York, near the junction of the latter stream with the Delaware. The southern half of the valley between the ridge and the mountain is drained by Flatbrook. At the mouth of Flatbrook, the Delaware river describes the great, sigmodial, Wallpack bend, cutting through the Wallpack ridge, whose more south-

John Bigart, about two miles south of the New York State line. This Nearpass section is described in detail at this place, because it will be used as a basis for the descriptions of most of the following formations, with their faunas, of both Silurian and Devonian ages. In this section the actual succession of the beds can be worked out in greater detail than at any other locality on the Wallpack ridge, although in some cases particular beds are better exposed elsewhere. The continuous rock exposure in the Nearpass quarry bluff is about 150 feet, but between the top of this exposure and the main crest of the ridge there are some 700 feet of strata which are not continuously exposed but whose harder layers make persistent outcrops.

Locality 2 A.—The Nearpass section, from below upward.

Poxino Island Shale.

2 A^1.	Buff-colored or yellow, calcareous shale or shaley limestone, with dendritic markings along the joints and bedding planes. 1 ft.	1 ft.

Bossardville Limestone.

2 A^2.	Fine-grained thinly-bedded, gray or blue limestone. At times so thinly bedded as to be essentially a calcareous shale; the thin laminæ being frequently alternately light and dark gray, giving to the rock a banded appearance. 12 ft. 4 in.	13 ft. 4 in.

Decker Ferry Formation.

2 A^3.	Highly fossiliferous, earthy, somewhat arenaceous limestone. 2 ft.	15 ft. 4 in.
2 A^4.	Hard, blue or gray, crystalline limestone, with many fossils. 14 ft. 2 in.	29 ft. 6 in.
2 A^5.	Fissile, calcareous, earthy shale, with some limestone bands. 6 ft. 9 in.	36 ft. 3 in.
2 A^6.	Hard, blue, crystalline limestone, similar to 2 A^3. 8 in.	36 ft. 11 in.

2 A^{7}.	Earthy shale, with bands of crystalline limestone. 5 in.	37 ft. 4 in.
2 A^{8}.	Red, crystalline limestone, abundantly fossiliferous. 2 ft. 6 in.	39 ft. 10 in.
2 A^{9}.	Fissile, earthy shale, with some irregular limestone bands. 9 in.	40 ft. 7 in.
2 A^{10}.	Blue, crystalline limestone, with an abundance of fossils. Some beds are largely composed of broken crinoid stems. 7 ft. 4 in.	47 ft. 11 in.
2 A^{11}.	Rather thick-bedded, calcareous shale, with thin bands of limestone. 7 ft. 3 in.	55 ft. 2 in.
2 A^{12}.	Thin and often irregularly bedded, coralline limestone, with an abundance of fossils. 6 ft.	61 ft. 2 in.
2 A^{13}.	Blue, crystalline limestone, in beds from six to ten inches thick, separated by shaley seams. Fossils common, many ostracodes. 4 ft.	65 ft. 2 in.

Rondout Formation.

2 A^{14}.	Earthy shale, with limestone bands. 3 ft. 9 in.	68 ft. 11 in.
2 A^{15}.	Fine-grained, dark limestone. 6 ft. 4 in.	75 ft. 3 in.
2 A^{16}.	Thin-bedded, calcareous shale. 1 ft. 6 in	76 ft. 9 in.
2 A^{17}.	Hard, fine-grained, blue or gray, brittle limestone. 2 ft. 3 in.	79 ft.
2 A^{18}.	Thin-bedded, calcareous shale. 5 ft. 3 in.	84 ft. 3 in.

2 A^{23}. Hard, bluish-black limestone, similar to 2 A^{21}. 1 ft. 6 in. 112 ft. 3 in.

2 A^{24}. Hard, bluish-black, semi-crystalline limestone, with many fossils. 5 ft. 117 ft. 3 in.

2 A^{25}. Hard, nearly black limestone, with bands of fossils. 9 ft. 8 in. 126 ft. 11 in.

2 A^{26}. Hard, fine-grained, knotty, blue limestone, with some bands of fossils. 12 ft. 138 ft. 11 in.

Coeymans Limestone.

2 A^{27}. Coarser-grained, crystalline, gray limestone, with masses of Favosites. 10 ft. 3 in. 149 ft. 2 in.

2 A^{28}. Not exposed. 30 ± ft. 180 ft.

New Scotland Beds.

2 A^{29}. Hard, cherty limestone, abundantly fossiliferous. Ledge exposed just back of the Sanford Nearpass quarry. 20 ± ft. 200 ft.

2 A^{30}. Soft shale, with some limestone bands, mostly unexposed. Fossils numerous in some beds. 140 ± ft. 340 ft.

Becraft Limestone.

2 A^{31}. Hard, dark or gray, cherty limestone, continuously exposed for about one-half mile along the crest of a low ridge back of the summit of the Nearpass quarry bluff. Abundantly fossiliferous. 20 ± ft. 360 ft.

Kingston Beds.

2 A^{32}. Unexposed beds, probably more or less shaley. 80 ± ft. 440 ft.

Oriskany Formation.

$2\ A^{33}$. Hard, more or less siliceous, gray or black limestone, with an abundance of fossils, many of which are trilobite fragments. The "Trilobite bed" of authors. Exposed continuously along the crest of the first high ridge back from the Nearpass quarry bluff. 30 ± ft. 470 ft.

$2\ A^{34}$. The *Orbiculoidea jervensis* bed, exposed in the Nearpass section only on the Werden farm next north of the Sanford Nearpass place, near the private road leading over the hill to the gravel pits. It is dark, siliceous limestone. 20 ± ft. 490 ft.

$2\ A^{35}$. More or less earthy or siliceous limestone, usually unexposed. 120 ± ft. 610 ft.

Esopus Grit.

$2\ A^{36}$. Exposed in the ridges beyond the Trilobite ridge in the Nearpass section and forming the northwestern slope of the Wallpack ridge. It is a hard, siliceous, irregularly-cleaved slate, which has been greatly sheared, and forms the crest of the Wallpack ridge near the State line and also in Wallpack township. 400 ± ft. 1,010 ft.

In this section the beds up to and including $2\ A^{26}$ have been care- [redacted]

POXINO ISLAND SHALE.

The summit of the Medina formation in New Jersey has not been observed, but the lowest formation above that sandstone and having outcrops in the State is a buff or greenish, calcareous shale, irregularly bedded, in layers one inch or less in thickness. In the bottom of the Nearpass section about one foot of this rock is exposed in an excavation which has been made in the talus slope at the foot of the bluff. South of Hainesville is another exposure, where a quantity of the material has been excavated for road-making purposes. Other exposures occur at several points south of Wallpack Centre, but nowhere have fossils of any description been observed.

This formation was first described by I. C White,* from Pennsylvania, in the southwestern extension of the Wallpack ridge, but he observed no outcrops in New Jersey. The base of the formation has not been observed in New Jersey, but in Pennsylvania it is described by White as resting upon a thin limestone formation, which, in turn, rests upon the Medina. It is said to be at least 200 feet in thickness in Pennsylvania, but only a small fraction of this thickness is exposed anywhere in New Jersey.

BOSSARDVILLE LIMESTONE.

Lying above the Poxino Island shales is a fine-grained, compact, bluish-gray, banded limestone. It is exposed in the Nearpass section, in the excavation already mentioned, where its entire thickness is twelve feet four inches. From this point south to Peter's Valley but few outcrops are to be seen, but between Peter's Valley and Flatbrookville there are many excellent exposures. The thickness of the formation is greatly increased to the south, and although no exact measurements could be made, it is at least 100 feet thick below Wallpack Centre. This formation is without question a northward extension of the limestone in Pennsylvania, designated by White† as the Bossardville limestone. It is, also, the formation which was called the "Ribbon limestone" by Professor Cook,‡ and which was erroneously correlated by him with the "Ribbon limestone" at Rondout, New York, which is the Manlius or "Tentaculite" limestone lying above the Rondout waterline formation. This correlation of the Bossardville limestone was also adopted by White in his Pennsylvania report. As a matter of fact, the age of the Bossardville limestone is very much greater than that of the Manlius limestone at Rondout, although the two formations are somewhat similar in lithologic characters. The Bossardville limestone itself is entirely barren of fossils, but it is followed by a series of beds which are highly fossiliferous, containing a well-defined, Silurian fauna.

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* Second Geol. Surv. Penn., Rep. G. 6, p. 145.

† Loc. cit., p. 141.

‡ Geol. of N. J., p. 156 (1868).

DECKER FERRY FORMATION.

In his report on Pike and Monroe counties, Pennsylvania, White* has described three formations succeeding the Bossardville limestone, which he designates by the name Decker Ferry, from the ferry of this name below Flatbrookville—the Decker Ferry shale, the Decker Ferry sandstone and the Decker Ferry limestone. The first two of these formations are closely allied, the so-called shale being an alternation of thin sandstone beds with thin beds which are more calcareous, rather than a true shale. These two formations of White will here be included in a single division, and will be called the Decker Ferry formation. The Decker Ferry limestone of White is quite distinct, both faunally and lithologically, from the Decker Ferry formation here recognized.

preserved. Near the lime-kiln at Flatbrookville, in a bed a fraction of an inch in thickness, at the very base of the formation, there are numerous specimens of a species of *Leperditia,* which has been described in the present report as *L. altoides* n. sp. This thin bed may be considered as lying at the contact of the Decker Ferry formation with the Bossardville limestone. In lithologic character it resembles the underlying beds, but is darker colored. It is followed for a few inches by an alternation of fine-grained limestone and more coarsely-grained, crystalline limestone, in layers less than an inch in thickness, the more crystalline layers containing the typical fossils of the higher Decker Ferry beds.

The only complete exposure of the entire formation is in the Nearpass quarry bluff, and the Decker Ferry section at this locality, with its succession of fossil faunas, will be first described, after which the faunas of the formation from other localities will be discussed.

Locality 2 A.—William Nearpass quarry, two miles south of Tri-States, New York.

2 A^3. Highly fossiliferous, earthy, somewhat arenaceous limestone, resting upon the Bossardville limestone. 2 ft.

1. *Zaphrentis* sp. undet.
2. *Monotrypa corrugata* n. sp.
3. *Pholidops ovata* Hall.
4. *Stropheodonta bipartita* (Hall).
5. *Orthothetes deckerensis* n. sp.
6. *Chonetes jerseyensis* Weller.
7. *Dalmanella postelegantula* n. sp.
8. *Rhynchonella deckerensis* n. sp.
9. *Rhynchonella agglomerata* n. sp.
10. *Atrypa reticularis* (Linn.).
11. *Reticularia bicostata* (Van.).
12. *Edmondia? deckerensis* n. sp.
13. *Pterinea* sp. undet.
14. *Ptychopteria? subquadrata* n. sp.
15. *Mytilarca obliqua* n. sp.
16. *Goniophora* sp. undet.
17. *Straparollus* sp. undet.
18. *Loxonema* sp. undet.
19. *Orthoceras* sp. undet.
20. *Proetus? depressus* n. sp.

21. *Dalmanites aspinosa* n. sp.
22. Undetermined ostracodes.

2 A^4. Hard, blue or gray, crystalline limestone, with many fossils, which are less perfectly preserved than those in the subjacent bed. 14 ft. 1 in.

1. *Favosites* sp. undet.
2. *Monotrypa corrugata* n. sp.
3. *Stropheodonta bipartita* (Hall).
4. *Orthothetes deckerensis* n. sp.
5. *Chonetes jerseyensis* Weller.
6. *Dalmanella postelegantula* n. sp.
7. *Rhynchonella deckerensis* n. sp.
8. *Rhynchonella agglomerata* n. sp.
9. *Atrypa reticularis* (Linn.).
10. *Reticularia bicostata* (Van.).
11. *Cyrtina magnaplicata* n. sp.
12. *Lichenalia?* sp. undet.
13. *Ptilodictya* sp. undet.
14. *Platyceras* sp. undet.

2 A^5. Fissile, calcareous, earthy shale, with limestone bands. No fossils observed. 6 ft. 9 in.

2 A^6. Hard, blue, crystalline limestone, similar to 2 A^4. Fossils poorly preserved. 8 in.

2 A^7. Earthy shale, with bands of crystalline limestone. Fossils in the limestone. 5 in.

1. *Stropheodonta bipartita* (Hall).
2. *Chonetes jerseyensis* Weller.

10. *Chonetes jerseyensis* Weller.
11. *Orthis flabellites* Foerste.
12. *Dalmanella postelegantula* n. sp.
13. *Rhipidomella preoblata* n. sp.
14. *Pentamerus circularis* n. sp.
15. *Rhynchonella deckerensis* n. sp.
16. *Rhynchonella agglomerata* n. sp.
17. *Atrypa reticularis* (Linn.).
18. *Spirifer* sp. undet.
19. Undetermined pelecypod.
20. *Calymene camerata* Con.

2 A^{9}. Fissile, earthy shale, with some irregular limestone bands. No fossils observed. 9 in.

2 A^{10}. Blue, more or less crystalline limestone, with an abundance of fossils. 7 ft. 4 in.

1. *Cladopora rectilineata* n. sp.
2. *Escharopora siluriana* n. sp.
3. *Strophcodonta bipartita* (Hall).
4. *Orthothetes interstriatus* (Hall).
5. *Orthothetes deckerensis* n. sp.
6. *Leptæna rhomboidalis* (Wilck.).
7. *Dalmanella postelegantula* n. sp.
8. *Rhynchonella agglomerata* n. sp.
9. *Atrypa? lamellata* Hall.
10. *Spirfer vanuxemi* var. *minor* n. var.
11. *Whitfieldella?* sp. undet.
12. *Mytilarca* sp. undet.
13. *Pterinea emacerata* (Con.)?
14. Undetermined pelecypod.
15. *Proetus pachydermatus* Barrett.

2 A^{11}. Rather thick-bedded, calcareous shale, with thin limestone bands. 7 ft. 3 in.

2 A^{12}. Irregularly bedded, coralline limestone, with an abundance of fossils. 6 ft.

1. *Zaphrentis* sp. undet.
2. *Diphyphyllum integumentum* Barrett.
3. *Cladopora rectilineata* n. sp.
4. *Favosites pyriformis* (Hall).
5. *Prismatophyllum inequalis* (Hall).
6. *Halysites catenularia* (Linn.).

7. *Stromatopora concentrica* Goldf.
8. *Monotrypa corrugata* n. sp.
9. *Spirorbis* sp. undet.
10. *Pholidops ovata* Hall.
11. *Stropheodonta bipartita* (Hall).
12. *Leptæna rhomboidalis* (Wilck.).
13. *Orthothetes interstriatus* (Hall).
14. *Rhynchonella agglomerata* n. sp.
15. *Wilsonia globosa* n. sp.
16. *Atrypa? lamellata* (Hall).
17. *Rhynchospira formosa* (Hall).
18. *Whitfieldella nucleolata* (Hall).
19. *Actinopteria reticulata* n. sp.
20. Undetermined gastropod.
21. *Proetus pachydermatus* Barrett.
22. *Calymene camerata* Con.
23. *Beyrichia sussexensis* n. sp.
24. *Beyrichia barretti* n. sp.

2 A^{13}. Blue, crystalline limestone, in beds from six to ten inches in thickness, with shaley partings between. Fossils common, many ostracodes. 4 ft.

1. *Pholidops ovata* Hall.
2. *Rhynchonella agglomerata* n. sp.
3. *Atrypa? lamellata* Hall.
4. *Whitfieldella nucleolata* (Hall).
5. *Actinopteria* sp. undet.
6. Undetermined pelecypods.

The lower strata of the formation, 2 A^3 to 2 A^7, inclusive, or all the beds up to the red limestone, are particularly characterized by the species which has been described as *Chonetes jerseyensis*. All of these beds which are fossiliferous at all, carry essentially the same fauna, and this life zone may be designated as the *Chonetes jerseyensis* zone.

The second faunal zone is essentially restricted to the red limestone bed 2 A^8. The fauna of this bed has a character of its own, distinct from that of either the subjacent or superjacent strata—it being characterized by the large number of specimens of the bryozoan, *Ptilodictya frondosa.* The name of this species may be used for the designation of this faunal zone. In an earlier, preliminary report on these faunas* the writer identified this species with an Ohio species, *Ptilodictya platyphylla* Jas., which is, in reality, a member of the genus *Phænopora*, but a microscopic study of the specimens has shown this identification to be incorrect, and has shown that the New Jersey specimens belong to an hitherto undescribed species. The earlier designation of this zone, then—*Ptilodictya platyphylla* zone—has to give way for the name *Ptilodictya frondosa* zone.

The beds lying above the *Ptilodictya frondosa* zone, up to and including 2 A^{13}, are not characterized by one homogeneous fauna, although they are characterized throughout by the species *Atrypa? lamellata,* and may, therefore, be designated as the *Atrypa lamellata* zone. There are really three subzones here included—the first, or lower one, having its fauna typically represented in bed 2 A^{10}; the second, in bed 2 A^{12}, which is characterized by the great abundance of corals, and may be called the coralline zone, and the third, in bed 2 A^{13}, characterized by the abundance of members of the ostracode genus *Beyrichia,* may be called the *Beyrichia* zone.

In most cases the Decker Ferry faunas, in whatever localities they have been found in the State, may be definitely referred to one or the other of these faunal zones recognized in the Nearpass section.

Locality 8 A.—On the next farm south of that upon which the William Nearpass quarry is located, and in a southward continuation of the quarry bluff, the lower Decker Ferry beds are exposed. The following species of fossils have been identified from here:

1. *Favosites* sp. undet.
2. *Monotrypa corrugata* n. sp.

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*Ann. Rep. State Geol. N. J. for 1899, p. 12.

3. *Stropheodonta bipartita* (Hall).
4. *Orthothetes deckerensis* n. sp.
5. *Chonetes jerseyensis* Weller.
6. *Dalmanella postelegantula* n. sp.
7. *Rhynchonella deckerensis* n. sp.
8. *Rhynchonella agglomerata* n. sp.
9. *Atrypa reticularis* (Linn.).
10. *Reticularia bicostata* (Van.).
11. *Edmondia? deckerensis* n. sp.
12. *Nucula?* sp. undet.
13. *Ptychopteria? subquadrata* n. sp.
14. *Platyceras* sp. undet.
15. *Proetus? spinosus* n. sp.
16. *Dalmanites aspinosa* n. sp.

This fauna belongs in the *Chonetes jerseyensis* zone of the formation, and is essentially identical with that from bed $2\ A^3$ of the quarry section, and the bed containing it is, perhaps, continuous with $2\ A^3$.

Locality 15 A.—On the farm of Mr. G. N. Cole, one and one-fourth miles southeast of Brick House, the red limestone stratum of the Decker Ferry formation is well exposed near the road. No opportunity was afforded to secure a collection of fossils at this locality, but the presence of the characteristic species of the *Ptylodictya frondosa* zone was observed. A little search would doubtless bring to light a good fauna from here, and it is altogether probable that the faunas of the lower and of the higher life zones of the formation could also be detected.

In this list characteristic species from both the *Ptilodictya frondosa* zone and the *Atrypa? lamellata* zone are recorded, but they are not mingled in the same beds. The two zones are just as distinctly separated here as in the Nearpass section. Masses of the red limestone, with its typical *Ptilodictya frondosa,* are scattered about, but most of the loose material, as well as the ledges *in situ,* evidently belong to beds higher than the red limestone, in the *Atrypa? lamellata* zone. No evidence of the presence of the *Chonetes jerseyensis* fauna has been detected, and the lower beds of the formation bearing this fauna are doubtless more deeply drift covered than the others.

Locality 25 B.—In the fields one-half mile southwest of Hainesville many of the Silurian and Devonian formations are more or less well exposed. Towards the east the beds of the Poxino Island shale have been excavated for road material; west of the exposure of this formation comes a ridge of Bossardville limestone, and beyond that are exposures of the Decker Ferry formation. From a brownish sandstone, near the base of the formation at this locality, the following species were collected:

1. *Monotrypa corrugata* n. sp.
2. *Stropheodonta bipartita* (Hall).
3. *Orthothetes deckerensis* n. sp.
4. *Chonetes jerseyensis* Weller.
5. *Rhynchonella agglomerata* n. sp.
6. *Atrypa reticularis* (Linn.).
7. *Reticularia bicostata* (Van.).
8. *Dalmanites* sp. undet.

This fauna is characteristically that of the *Chonetes jerseyensis* zone, as might be expected from its low position in the formation. No collections from the other portions of the formation have been made at this locality, but scattered over the surface on the summit of a low hill, the coralline bed was observed with an abundance of weathered coral masses of the same species as those in the Nearpass section. A careful study of the locality would undoubtedly furnish an abundance of excellent Decker Ferry fossils.

Locality 52 A.—In a bluff east of the road to Flatbrookville, and about one and three-fourths miles below Peter's Valley, the Decker Ferry formation is exposed through a thickness of more than eighty feet, although the base of the formation is covered. The major portion of the beds at this locality are sandstones, but interstratified with the arenaceous beds there are occasionally thin bands of limestone, in which fossils occur in a sufficiently perfect state of preservation to be identified. From a thin limestone bed, fifty feet above the base of the exposure at this locality, the following species have been identified:

1. *Escharopora siluriana* n. sp.
2. *Stropheodonta bipartita* (Hall).
3. *Rhynchonella agglomerata* n. sp.
4. *Atrypa? lamellata* Hall.
5. *Whitfieldella nucleolata* (Hall).

From another thin limestone band, twenty-five feet higher than the last, the following species have been identified:

1. *Diphyphyllum integumentum* Barrett.
2. *Zaphrentis* sp. undet.
3. *Orthothetes interstriatus* (Hall).
4. *Whitfieldella nucleolata* (Hall).
5. *Leperditia* sp. undet.

Both of these small groups of species indicate a horizon in the *Atrypa? lamellata* zone of the Decker Ferry formation. The lower one, containing the bryozoan, *Escharopora siluriana,* may be definitely referred to the lower beds of this zone, while the upper one suggests the coralline zone, although the corals are not so abundantly represented as they normally are in this life zone.

Locality 71 B.—This locality is on the road to Flatbrookville, about three-fourths of a mile below Wallpack Center. The rocks are ex-

1. *Zaphrentis* sp. undet.
2. *Monotrypa corrugata* n. sp.
3. *Chonetes jerseyensis* Weller.
4. *Rhynchonella agglomerata* n. sp.
5. *Atrypa reticularis* (Linn.).

Locality 109 B.—At Flatbrookville, along the creek below the lime-kiln, the lower beds of the Decker Ferry formation are finely exposed, and may be seen resting directly upon the Bossardville limestone. At this locality the beds contain a large amount of arenaceous material, but in the more or less calcareous beds intercalated in the sandstone, fossils are abundant, the commonest species being *Chonetes jerseyensis*. The species which have been identified from here are as follows:

1. *Favosites corrugatus* n. sp.
2. *Monotrypa corrugata* n. sp.
3. *Stropheodonta bipartita* (Hall).
4. *Orthothetes deckerensis* n. sp.
5. *Chonetes jerseyensis* Weller.
6. *Dalmanella postelegantula* n. sp.
7. *Rhynchonella deckerensis* n. sp.
8. *Rhynchonella agglomerata* n. sp.
9. *Atrypa reticularis* (Linn.).
10. *Reticularia bicostata* (Van.).
11. *Whitfieldella?* sp. undet.
12. Undetermined ostracode.

At Flatbrookville the only Decker Ferry fauna which has been observed is that of the *Chonetes jerseyensis* zone, above described. It is possible that the higher faunas might be detected after a careful search, but the higher beds are highly arenaceous, with fossils rarely present or very poorly preserved.

Locality 167 A.—Outside of the Delaware valley the Decker Ferry formation occurs in the Green Pond mountain region, where it overlies the red, arenaceous, Longwood shales. In this region its thickness does not exceed forty or fifty feet. At the period of its deposition the formation was probably continuous across the interval between the Delaware valley and the Green Pond region, thinning out to the east, having since been removed by erosion. The most fossiliferous locality in the Decker Ferry formation of the Green Pond region is on the Cobb property, one and one-half miles south of Newfoundland, and the following species have been identified from there:

1. *Favosites corrugatus* n. sp.
2. *Monotrypa corrugata* n. sp.
3. *Chonetes jerseyensis* Weller.
4. *Orthis flabellites* Foerste.
5. *Rhynchonella deckerensis* n. sp.
6. *Rhynchonella agglomerata* n. sp.
7. *Atrypa reticularis* (Linn.).
8. *Dalmanites aspinosa* n. sp.

Locality 187 A.—A second locality in the Green Pond region which has furnished fossils from the Decker Ferry formation is in an abandoned quarry at Upper Longwood, and the following species have been identified:

1. *Monotrypa corrugata* n. sp.
2. *Stropheodonta bipartita* (Hall).
3. *Chonetes jerseyensis* Weller.
4. *Orthis flabellites* Foerste.
5. *Rhynchonella deckerensis* n. sp.
6. *Rhynchonella agglomerata* n. sp.
7. *Atrypa reticularis* (Linn.).

The faunas at both of these Green Pond localities are typical of the lower or *Chonetes jerseyensis* zone of the Decker Ferry formation, and the higher faunas have not been anywhere detected in the region. The only species of the fauna in the Green Pond region which does not occur in the *Chonetes jerseyensis* zone of the Delaware valley is *Orthis flabellites*, which, in the latter region, has been found only in the red limestone bed associated with the *Ptilodictya frondosa* fauna.

9. *Escharopora siluriana* n. sp.
10. *Pholidops ovata* Hall.
11. *Stropheodonta bipartita* (Hall).
12. *Leptæna rhomboidalis* (Wilck.).
13. *Orthothetes interstriatus* (Hall).
14. *Orthothetes deckerensis* n. sp.
15. *Chonetes jerseyensis* Weller.
16. *Orthis flabellites* Foerste.
17. *Dalmanella postelegantula* n. sp.
18. *Rhipidomella preoblata* n. sp.
19. *Pentamerus circularis* n. sp.
20. *Rhynchonella deckerensis* n. sp.
21. *Rhynchonella agglomerata* n. sp.
22. *Wilsonia globosa* n. sp.
23. *Atrypa reticularis* (Linn.).
24. *Atrypa? lamellata* Hall.
25. *Spirifer vanuxemi* var. *minor* n. var.
26. *Cyrtina magnaplicata* n. sp.
27. *Reticularia bicostata* (Van.).
28. *Rhynchospira formosa* Hall.
29. *Whitfieldella nucleolata* (Hall).
30. *Edmondia deckerensis* n. sp.
31. *Pterinea emacerata* (Con.).
32. *Pteronites? subplana* (Hall).
33. *Ptychopteria? subquadrata* n. sp.
34. *Actinopteria reticulata* n. sp.
35. *Mytilarca obliqua* n. sp.
36. *Proetus pachydermatus* Barrett.
37. *Proetus depressus* n. sp.
38. *Proetus spinosus* n. sp.
39. *Calymene camerata* Con.
40. *Dalmanites aspinosa* n. sp.
41. *Leperditia altoides* n. sp.
42. *Beyrichia sussexensis* n. sp.
43. *Beyrichia barretti* n. sp.
44. *Beyrichia perinflata* n. sp.
45. *Beyrichia jerseyensis* n. sp.
46. *Beyrichia nearpassi* n. sp.
47. *Beyrichia deckerensis* n. sp.
48. *Bythocypris nearpassi* n. sp.

Of this list of forty-eight species, twenty-nine are described for the first time in the present report, and three of those previously described —*Diphyphyllum integumentum* Barr., *Chonetes jerseyensis* Weller and *Proetus pachydermatus* Barr.—came originally from the Decker Ferry fauna of New Jersey, and have not been reported elsewhere. This leaves but sixteen species in the fauna which may be used for direct comparison with other faunas. Of these sixteen species, six—*Prismatophyllum inequalis* (Hall), *Stropheodonta bipartita* (Hall), *Orthothetes interstriatus* (Hall), *Atrypa? lamellata* Hall, *Whitfieldella nucleolata* (Hall) and *Calymene camerata* Con.—were originally described from the Coralline limestone of Eastern New York, and are characteristic of the fauna of that formation. Among these six species are to be found some of the most characteristic species of the Decker Ferry fauna of New Jersey. Five of the sixteen species —*Favosites pyriformis* (Hall), *Orthis flabellites* Foerste, *Reticularia bicostata* (Van.), *Pterinea emacerata* (Con.) and *Pteronites subplana* (Hall)—have been described from the Niagaran faunas of the interior of the continent, but of these the two pelecypods are, perhaps, somewhat doubtful, and the identification of *Orthis flabellites* is not entirely satisfactory. *Reticularia bicostata* has only been recorded from the extreme eastern extension of the Niagaran strata, in Oneida county, New York, and the beds of the Coralline limestone are known to extend as far west as Herkimer county, which is adjacent to Oneida county on the east, and it is possible that careful field work would show the species to be really a member of the Coralline fauna and not of the typical Niagaran fauna; at any rate, the species is not one of the typical Niagaran species of the interior of the continent. The identification of *Favosites pyriformis* is entirely satisfactory, and [redacted] and it is believed that the beds containing the upper faunal zone of the formation, characterized by *Atrypa? lamellata,* may be definitely correlated with the Coralline limestone of New York, and that the entire Decker Ferry formation is the southern extension of that formation. The coralline age of these beds was first recognized by Dr. S. T. Barrett,* a local geologist of Port Jervis, and to him credit is due for the first announcement of the presence of strata in the New Jersey section referable to the Coralline limestone of Eastern New York.

Among the species which are unknown except in the Decker Ferry fauna we find forms more or less closely allied to Western Niagaran and to Helderbergian species, but there seem to be sufficient differences in all cases to constitute distinct species. Among the orthids, both *Dalmanella postelegantula* and *Rhipidomella preoblata* are intermediate in their characters between Niagaran and Helderbergian species. *Rhynchonella deckerensis* and *Rhynchonella agglomerata* are both probably ancestral to Helderbergian species. *Wilsonia globosa* is of a Silurian type, the similar rhynchonelloids of the Helderbergian faunas being members of the genus *Uncinulus*. The small variety of *Spirifer vanuxemi,* called var. *minor,* is closely allied to the typical form of the species, which is one of the most characteristic Manlius limestone species.

In his original description of the fauna of the Coralline limestone, Hall† considered these beds in Eastern New York to be the eastward extension of the Niagaran strata in the western portion of the State. The great dissimilarity between the Coralline or Decker Ferry fauna, however, and that of the Niagaran formations further west indicates that the strata containing the two faunas were deposited in two distinct basins of sedimentation, which were either entirely separated from each other by a land barrier or their connection was very slight or indirect. The great interior epicontinental sea of Niagaran time is believed to have had its connection with the oceanic waters by a northern passage through the Hudson bay.‡ The Decker Ferry fauna lived in a sea which has been called the Cumberland basin by Ulrich and Schuchert,§ which occupied a rather long and narrow area in the Appalachian region and had its oceanic connection with the Atlantic in the neighborhood of Chesapeake bay. Although deposited in an entirely distinct basin, the Decker Ferry formation, as well as the subjacent beds down to the Medina formation, were probably contemporaneous with some portion or the whole of the Niagaran formations of the interior.

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* Ann. N. Y. Acad. Sci., vol. I, pp. 121-124 (1878); Am. Jour. Sci. (3), vol. XV., pp. 370-372 (1878).

† Pal. N. Y., vol. II., p. 321.

‡ Jour Geol., vol. VI., pp. 692-703.

§ Rep. N. Y. State Pal. for 1901, p. 649.

The incursion of faunas from the exterior into the Cumberland basin culminated with the Helderbergian faunas, and for that reason Ulrich and Schuchert* have spoken of that chapter in the faunal history of North America, covering the history of the life of the Cumberland basin, as the Helderbergian invasion. The earliest faunal evidence of this invasion in New Jersey is to be found in the Decker Ferry formation, but further south, according to Ulrich and Schuchert, there are faunas belonging to this invasion older than the Decker Ferry of New Jersey.

The Decker Ferry fauna is allied to the Silurian faunas of the Atlantic province, which extends along the Atlantic border in New England and Eastern Canada, but sufficiently detailed study of these eastern Silurian faunas for detailed comparison with other faunas has never been made.

RONDOUT FORMATION.

In the Nearpass section the thirty-nine feet of strata lying above the Decker Ferry formation are referred to the Rondout formation. The beds consist of more or less earthy shales and limestones, which are usually sparsely fossiliferous, although in some beds ostracode crustaceans belonging to the genus *Leperditia* are abundant. But a single specimen of a brachiopod has been found in these beds in New

2 A^{18}. Thin-bedded, calcareous shale. 5 ft. 3 in.
  1. *Leperditia alta* (Con.)?
2 A^{19}. Earthy limestone, weathering to a buff color. The "Peth stone" of Professor Cook's report. 5 ft.
  1. Undetermined foraminifera or ostracodes.
2 A^{20}. Thin-bedded, crumpled shale, with some bands of denser limestone. 15 ft.
  1. *Leperditia alta* (Con.).

This formation occurs at various localities throughout the entire length of the Wallpack ridge in New Jersey, but it is usually covered in the sections, and no detailed study of it has been made, except at the Nearpass quarry.

The original definition of the Rondout formation by Clark and Schuchert* is not entirely satisfactory. At Rondout, New York, where the typical section of the formation occurs, there are two cement beds quarried or mined, which are separated by a series of strata which do not possess the necessary properties for the manufacture of cement. Clark and Schuchert seem to have included this entire series of strata—the lower cement bed, the intermediate beds and the upper cement bed—in their Rondout formation. The intermediate beds are not abundantly fossiliferous, but a careful search during a short visit to the locality brought to light several species, all of which are characteristic of the Decker Ferry fauna of New Jersey, and it is believed that the strata separating the two cement beds at Rondout are to be considered as an extension of the Coralline limestone of New York and of the Decker Ferry formation of New Jersey. In this case the lower cement bed at Rondout may be directly correlated with the Bossardville limestone of New Jersey, which leaves only the upper cement bed to be included under the name Rondout formation, and it is in this restricted sense that the name of the formation is used in the New Jersey section. The beds lying between the Decker Ferry formation below and the Manlius limestone above are believed to be the southern extension of the upper cement bed at Rondout. In its southern extension the cement bed proper has become reduced in thickness, so that in the Nearpass section it is represented only by bed 2 A^{19}, which was described by Professor Cook† as the "Peth stone," but with the thinning of the cement bed proper, to the south, the associated shales and limestones have become increased in thickness.

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*Sci. N. S., vol. X., No. 259, pp. 874-878, and Am. Geol., vol. XXV., p. 119.

†Geol. N. J., 1868, p. 159.

The fauna of the Rondout formation, made up almost exclusively of members of the genus *Leperditia*, is a peculiar one, and must indicate some peculiar conditions of environment, but what these conditions may have been we do not know.

MANLIUS LIMESTONE.

The Manlius, or "Tentaculite," limestone of the older New York reports is a somewhat thinly-bedded, knotty, dark blue or almost black limestone. It is the bed which constitutes the quarry stone, and its outcrop may be traced throughout the entire length of the Wallpack ridge in New Jersey by the line of active or abandoned quarries and lime-kilns, its upper portion being the only limestone which is extensively used in this portion of the State for the manufacture of lime. The total thickness of beds in the Nearpass section referable to the formation is thirty-four feet and eight inches.

The fauna of the Manlius limestone is not a large one. Ostracodes still persist, but associated with them in some beds are several species and many individuals of brachiopods, with some gastropods and pelecypods and an occasional cephalopod. Specimens of Tentaculites, which are so abundant in this formation at some localities in New York State, and which gave rise to the older name of the formation, are among the rarest members of the fauna in New Jersey. One of the most characteristic species of the fauna, although it has not been noticed in the lowest beds, is *Spirifer vanuxemi*, and the life zone represented by the Manlius limestone may be called the *Spirifer vanuxemi* zone.

2 A^{23}. Hard, bluish-black limestone, similar to 2 A^{21}. 1 ft. 6 in.

1. *Leperditia alta* (Con.).

2 A^{24}. Hard, bluish-black, semi-crystalline limestone, with many fossils. 5 ft.

1. *Stropheodonta varistriata* (Con.).
2. *Spirifer vanuxemi* Hall.
3. *Megambonia aviculoidea* Hall.
4. *Holopea antiqua* (Van.).
5. *Tentaculites gyracanthus* (Eaton).
6. Undetermined cephalopod.
7. *Leperditia alta* (Con.).
8. *Beyrichia kümmeli* n. sp.

2 A^{25}. Hard, nearly black limestone, with bands of fossils. 9 ft. 8 in.

1. *Stropheodonta varistriata* (Con.).
2. *Centronella? biplicata* n. sp.
3. *Spirifer vanuxemi* Hall.
4. Undetermined pelecypod.
5. *Beyrichia smocki* n. sp.

2 A^{26}. Hard, fine-grained, knotty, blue limestone, with some bands of fossils. 12 ft.

1. *Stropheodonta varistriata* (Con.).
2. *Rhynchonella* sp. undet.
3. *Centronella? biplicata* n. sp.
4. *Spirifer vanuxemi* Hall.
5. Undetermined gastropod.
6. *Orthoceras* sp. undet.
7. *Beyrichia montiguensis* n. sp.

No collections of fossils have been made from the Manlius limestone at other localities, but the same species, especially *Spirifer vanuxemi, Stropheodonta varistriata* and *Leperditia alta,* have frequently been observed elsewhere. In a former preliminary report on the faunas of the Wallpack ridge* the Manlius limestone was associated with the superjacent Helderbergian formations rather than with the subjacent formations, but the transition from the Rondout to the Manlius is so gradual, both stratigraphically and faunally, that it has proved to be difficult to draw a sharp dividing line at this horizon.

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* **Ann. Rep. N. J. State Geol. for 1899.**

The conditions which obtained in the region under discussion during the time of deposition of the Rondout formation were peculiar, as is shown by the almost entire absence of all organisms except ostracodes belonging to the genus *Leperditia*. In the earlier report it was suggested that these ostracode faunas in some way represented the *Eurypterus* fauna of the "waterline" formation of Western New York, but it now seems clear that the New Jersey formations of this period were deposited in a distinct basin, which probably had no direct connection with the contemporaneous interior sea. It is possible that these *Leperditia* faunas lived under non-marine, perhaps brackish water conditions, as was formerly suggested, although these conditions may have been more or less local, and may not have existed throughout the entire Cumberland basin. At any rate, in that portion of the Cumberland basin which is now included in New Jersey, the conditions were not favorable during Rondout time for the existence of the typical marine faunas of the period, with an abundance of brachiopods, trilobites, &c. Brachiopods did exist, however, in this portion of the Cumberland basin at this time, though rarely, as is shown by the presence of *Hyattella? lamellosa.*

In the lower beds of the Manlius limestone there is evidence of environmental conditions similar to those of the Rondout. *Leperditia* still remains the most common form of life, but associated with this ostracode are other organisms, especially stromatoporoids, and an occasional pelecypod. In the middle portion of the formation *Leperditia*

CHAPTER V.

FORMATIONS OF DEVONIAN AGE.

COEYMANS LIMESTONE.

The Helderbergian faunas in New Jersey do not differ essentially from those in New York. The same faunal zones are recognized, and nearly all of the species identified are New York forms, which are in no way different from specimens occurring in the typical Helderbergian localities.

The Coeymans limestone is the first of the Helderbergian formations, and in the Nearpass section it has an estimated thickness of forty feet, though only the lowermost beds are actually exposed. It lies upon the Manlius limestone, in the top of the Nearpass bluff, differing from the subjacent formation in its coarser and more crystalline texture and in its lighter color. Frequently more or less chert is mingled with the limestone. The lithologic transition from the Manlius to the Coeymans limestone is not abrupt, but is accomplished within a thickness of a few feet.

The Coeymans fauna is far more prolific than that of the Manlius limestone, and has an altogether different composition. The most characteristic species of the fauna, wherever it occurs, is *Gypidula galeata*, and the faunal zone included in the Coeymans limestone may be spoken of as the *Gypidula galeata* zone. In the basal portion of the formation there are frequently numerous masses of the coral, *Favosites helderbergiæ*, usually more or less completely silicified, associated with masses of a concentrically laminated stromatoporoid. This coral bed in the Coeymans limestone of New Jersey is doubtless the southern extension of the coralline bed at the base of the same formation in New York.

No complete section of the Coeymans limestone has been exposed in New Jersey, and usually it is the lower portion of the formation which is exposed in the outcrops. If the beds could be studied in detail throughout the entire thickness of the formation several subordinate faunal zones might possibly be detected, but the exposures in New Jersey are nowhere sufficiently continuous to afford such a detailed study as it has been possible to make with the lower beds of the Nearpass section.

Locality 2 A^{27}.—The Coeymans fauna at this locality was collected from the basal ten feet of the formation at the top of the Nearpass quarry bluff. The following species of fossils have been identified:

1. *Favosites helderbergiæ* Hall.
2. *Stromatopora concentrica* Goldf.
3. *Ptilodictya lobata* n. sp.
4. *Lichenalia torta* Hall.
5. *Monotrypa sphærica* (Hall).
6. *Stropheodonta varistriata* (Con.).
7. *Stropheodonta planulata* Hall.
8. *Strophonella punctulifera* (Con.).
9. *Gypidula galeata* (Dal.).
10. *Rhynchonella semiplicata* (Con.).
11. *Rhynchonella transversa* Hall.
12. *Uncinulus mutabilis* (Hall).
13. *Atrypa reticularis* (Linn.).
14. *Spirifer cyclopterus* Hall.
15. *Meristella lævis* (Van.).
16. *Actinopteria communis* (Hall).
17. *Platyceras* sp. undet.
18. *Tentaculites elongatus* Hall.
19. *Proetus protuberans* Hall.
20. *Dalmanites pleuroptyx* (Green).

Locality 15 C.—At a single locality, one and three-fourths miles

6. *Fenestella* sp. undet.
7. *Gypidula galeata* (Dal.) var.
8. *Gypidula angulata* n. sp.
9. *Rhynchonella altiplicata* Hall.
10. *Uncinulus pyramidatus* (Hall).
11. *Rhynchotreta transversa* n. sp.
12. *Atrypa reticularis* (Linn.).
13. *Spirifer octocostatus* Hall.
14. *Spirifer concinnus* Hall.
15. *Cyrtina* sp. undet.
16. *Rhynchospira formosa* (Hall).
17. *Meristella lævis* (Van.).
18. *Nucleospira ventricosa* Hall.
19. *Rhombopteria clathratus* n. sp.
20. *Actinopteria communis* (Hall).
21. *Bulimorpha? helderbergæ* n. sp.
22. *Loxonema?* sp. undet.
23. *Platyceras gibbosum* Hall.

The composition of this fauna is quite different from any of those which have been studied from the lower beds of the Coeymans limestone. Its most conspicuous characteristics are—first, the entire absence of the genera *Stropheodonta* and *Strophonella,* which are usually among the commonest species of the Coeymans limestone; and second, the increased representation of the genus *Spirifer,* which is usually rare in the Coeymans fauna. In this last character the fauna approaches that of the superjacent New Scotland beds, where the species of *Spirifer* are among the commonest members of the fauna. Because of the presence of *Gypidula,* however, and especially of a varietal form of *Gypidula galeata,* the strata containing this fauna are retained in the Coeymans limestone.

Locality 37 A.—This locality is in the hillside, just above the large spring, a little over one-half mile northeast of Peter's Valley. The outcrop is in the lower portion of the Coeymans limestone, all of the higher beds being covered with drift. The Manlius limestone, also, outcrops at this locality, a little lower down the hillside. The species identified from here are as follows:

1. *Zaphrentis* sp. undet.
2. *Lichenalia torta* Hall.
3. *Stropheodonta varistriata* (Con.).

4. *Strophonella punctulifera* (Con.).
5. *Gypidula galeata* (Dal.).
6. *Rhynchonella semiplicata* (Con.).
7. *Rhynchonella altiplicata* Hall.
8. *Uncinulus mutabilis* (Hall).
9. *Atrypa reticularis* (Linn.).
10. *Spirifer cyclopterus* Hall.
11. *Meristella lævis* (Van.).
12. *Rhynchospira formosa* (Hall).
13. *Rhombopteria clathratus* n. sp.
14. *Conocardium* sp. undet.
15. *Tentaculites elongatus* Hall.
16. *Dalamanites pleuroptyx* (Green).
17. *Beyrichia* sp undet.

This fauna is essentially like that collected from the Coeymans limestone in the Nearpass section, and is the normal fauna of the *Gypidula galeata* zone.

Locality 71 A.—This locality is on the 619-foot hill, three-eighths of a mile northwest of Wallpack Center. The limestone at this point is very cherty, and the following species have been recognized:

1. *Strophonella punctulifera* (Con.).
2. *Leptæna rhomboidalis* (Wilck.).
3. *Gypidula galeata* (Dal.).
4. *Atrypa reticularis* (Linn.).
5. *Spirifer cyclopterus* Hall.

Locality 89 A.—The outcrop from which the fossils at this locality were secured is at the side of the road, one and one-half miles north-

Locality 109 A.—Just below Flatbrookville the Coeymans limestone is well developed, and in Elmer Garris' pasture fossils occur abundantly, both *in situ* and in loose masses of the limestone. The entire fauna collected at this locality is the normal *Gypidula galeata* fauna, and the following species have been identified:

1. *Stropheodonta varistriata* (Con.).
2. *Stropheodonta varistriata* var. *arata* Hall.
3. *Stropheodonta planulata* Hall.
4. *Stropheodonta indenta* (Con.).
5. *Strophonella punctulifera* (Con.).
6. *Orthothetes woolworthana* (Hall).
7. *Leptæna rhomboidalis* (Wilck.).
8. *Schizophoria bisinuata* n. sp.
9. *Gypidula galeata* (Dal.).
10. *Rhynchonella altiplicata* Hall.
11. *Uncinulus mutabilis* (Hall).
12. *Uncinulus nucleolatus* (Hall).
13. *Atrypa reticularis* (Linn.).
14. *Spirifer cyclopterus* Hall.
15. *Spirifer macropleurus* (Con.).
16. *Meristella lævis* (Van.).
17. *Rhynchospira formosa* (Hall).
18. *Lichenalia torta* Hall.
19. *Fenestella* sp. undet.
20. *Actinopteria communis* (Hall).
21. *Tentaculites elongatus* Hall.
22. *Dalmanites pleuroptyx* (Green).
23. *Phacops* sp. undet.

Of the entire fauna enumerated above, all the species except one, *Spirifer macropleurus,* were secured *in situ* from a single bed. Many of them have also been collected at the same locality from loose blocks of limestone. A single specimen of *Spirifer macropleurus* was found, and although not *in situ,* it was associated in the same block of limestone with *Gypidula galeata* and other typical Coeymans limestone species, so that its presence in the Coeymans limestone cannot be disputed. The specimen does not essentially differ from the New Scotland representatives of the species, except in its somewhat inferior size.

NEW SCOTLAND BEDS.

The formation following the Coeymans limestone in the New Jersey section is twofold. In its lower portion there are twenty feet, more or less, of a very hard, cherty limestone. Above this is a series of one hundred and forty feet, more or less, of calcareous shales. The fauna of the entire formation, including both the cherty limestone and the shale, is a prolific one, and has much in common throughout, it being especially characterized by the abundant representation of the genus *Spirifer*. In a previous preliminary report upon the Wallpack ridge* a hard, cherty limestone, overlying the shales, was included in the New Scotland beds, giving the entire formation a threefold character, instead of twofold, as here recognized. Further study seems to indicate that this upper, cherty limestone represents what has been described as the Becraft limestone of the New York section, although its fauna is intimately allied to that of the subjacent New Scotland beds. This faunal similarity is so great, although there are recognizable differences, that in the descriptive part of the present report the New Scotland and Becraft faunas are all described together.

Locality 2 A^{20}.—Nowhere in New Jersey is there a continuous section where the complete succession of the New Scotland beds, with their included faunas, can be studied in detail. The only outcrops available for observation are isolated, and such exposures of both the cherty limestone at the base and the higher shale beds are present in the Nearpass section. From the cherty limestone the species in the

11. *Dalmanella perelegans* (Hall).
12. *Dalmanella subcarinata* (Hall).
13. *Bilobites varica* (Con.).
14. *Scenidium insigne* (Hall).
15. *Uncinulus pyramidatus* (Hall).
16. *Eatonia medialis* (Van.).
17. *Centronella? subrhomboidea* n. sp.
18. *Spirifer perlamellosus* Hall.
19. *Spirifer cyclopterus* Hall.
20. *Meristella lævis* (Van.).
21. *Actinopteria* sp. undet.
22. *Strophostylus gebhardi* (Con.).
23. *Phacops logani* Hall.
24. *Dalamanites pleuroptyx* (Green).

Locality 2 A^{30}.—The higher beds of the upper, shaley member of the New Scotland beds are exposed in the Nearpass section, but not extensively. The following species of fossils have been identified:

1. *Streptelasma strictum* Hall.
2. *Stropheodonta beckei* Hall.
3. *Strophonella punctulifera* (Con.).
4. *Leptæna rhomboidalis* (Wilck.).
5. *Rhipidomella oblata* (Hall).
6. *Uncinulus vellicatus* (Hall).
7. *Eatonia medialis* (Van.).
8. *Spirifer macropleurus* (Con.).
9. *Spirifer perlamellosus* Hall.
10. *Spirifer cyclopterus* Hall.
11. *Trematospira multistriata* Hall.
12. *Nucleospira ventricosa* Hall.
13. *Anoplotheca concava* (Hall).
14. *Meristella lævis* (Van.).
15. *Actinopteria* sp. undet.
16. *Tentaculites elongatus* Hall.
17. *Dalmanites pleuroptyx* (Green).

The fauna of the shaley member of the New Scotland beds differs in some respects from that of the lower, cherty limestone, but they have many characters in common. The most notable additions to the shale fauna, species which are almost always present in these beds in the State, are *Spirifer macropleurus, Trematospira multistriata* and *Anoplotheca concava*. Another species which may be associated with these, but which happens to be absent from the fauna at the locality just described, is *Atrypina imbricata.* The presence of *Eatonia*, of many individuals of *Spirifer* and some of the same species of Orthid and Strophomenoid brachiopods are faunal characteristics which unite the two members of the New Scotland beds.

Locality 8 A.—This locality is one-half mile northeast from the first cross-road over the Walpack ridge, below the New York State line. It is a small excavation, which has been made in the shales of the New Scotland beds, and fossils are preserved in abundance, the following species having been identified:

1. *Stropheodonta beckei* Hall.
2. *Strophonella punctulifera* (Con.).
3. *Leptæna rhomboidalis* (Wilck.).
4. *Rhipidomella oblata* Hall.
5. *Eatonia medialis* (Van.).
6. *Spirifer macropleurus* (Con.).
7. *Spirifer perlamellosus* Hall.
8. *Spirifer cyclopterus* Hall.
9. *Atrypina imbricata* Hall.
10. *Anoplotheca concava* (Hall).
11. *Meristella lævis* (Van.).

This is the normal fauna of the shaley member of the New Scotland beds, characterized especially by *Spirifer macropleurus.*

Locality 25 C.—One-half mile below Hainesville there are excellent exposures of the New Scotland beds, both the basal, cherty limestone and the higher, shaley beds, and nowhere is there a better opportunity for the collection of fossils. From the lower, cherty beds at this

13. *Eatonia medialis* (Van.).
14. *Eatonia singularis* (Van.).
15. *Spirifer perlamellosus* Hall.
16. *Meristella lævis* (Van.).
17. *Actinopteria* sp. undet.
18. *Cypricardinia sublamellosa* Hall.
19. *Mytilarca* sp. undet.
20. *Strophostylus gebhardi* (Con.).
21. *Loxonema attenuata* Hall.
22. *Orthoceras* sp. undet.
23. *Phacops logani* Hall.
24. *Dalmanites pleuroptyx* (Green).

Locality 25 D.—This locality is near the last, it being the outcrop of the shaley beds of the New Scotland formation, which are exposed to the west of the cherty limestone outcrops. The following species of fossils have been identified:

1. *Stropheodonta beckei* Hall.
2. *Leptæna rhomboidalis* (Wilck.).
3. *Rhipidomella oblata* (Hall).
4. *Uncinulus vellicatus* (Hall).
5. *Eatonia medialis* (Van.).
6. *Eatonia singularis* (Van.).
7. *Spirifer macropleurus* (Con.).
8. *Spirifer cyclopterus* Hall.
9. *Trematospira multistriata* Hall.
10. *Atrypina imbricata* Hall.
11. *Anoplotheca concava* (Hall).
12. *Meristella lævis* (Van.).

Locality 52 A.—A little over one mile below Peter's Valley, in the side of the road crossing the ridge, an excavation for road material has been made in the shaley beds of the New Scotland formation. Some of the strata at this locality are fossiliferous, and the following species have been identified:

1. *Hindia fibrosa* (Roem.).
2. *Stropheodonta beckei* Hall.
3. *Strophonella punctulifera* (Con.).
4. *Leptæna rhomboidalis* (Wilck.).
5. *Orthostrophia strophomenoides* (Hall).
6. *Rhipidomella oblata* (Hall).
7. *Eatonia medialis* (Van.).

8. *Spirifer macropleurus* (Con.).
9. *Spirifer perlamellosus* Hall.
10. *Spirifer cyclopterus* Hall.
11. *Atrypina imbricata* Hall.
12. *Trematospira multistriata* Hall.
13. *Meristella lævis* (Van.).

Locality 109 A.—Below Flatbrookville, in beds lying above those carrying the *Gypidula galeatus* fauna, but separated from them by the Stormville sandstone, which will be described later, there are calcareous, shaley beds belonging in the New Scotland formation, which are much harder and tougher than is usually the case with the shaley member of this formation. These beds contain numerous fossils, and the following species have been identified:

1. *Streptelasma strictum* Hall.
2. *Stropheodonta beckci* Hall.
3. *Leptæna rhomboidalis* (Wilck.).
4. *Orthostrophia strophomenoides* (Hall).
5. *Rhipidomella oblata* Hall.
6. *Eatonia medialis* (Van.).
7. *Spirifer macropleurus* (Con.).
8. *Meristella lævis* (Van.).
9. *Dalmanites pleuroptyx* (Green).

A comparison of the faunas of the New Scotland beds with those enumerated from the Coeymans limestone shows several essential differences. In the Coeymans limestone *Gypidula galeatus* was always the most conspicuous member of the fauna, except at the very summit of the formation. In the New Scotland beds the species never occurs.

STORMVILLE SANDSTONE.

This formation is present only in the southern half of the Wallpack ridge in New Jersey, but, according to White,* who named the formation in Pennsylvania, it becomes a more and more conspicuous formation to the south, and gradually replaces the more calcareous and shaley strata until it occupies the entire interval between the Coeymans limestone and the Oriskany sandstone, becoming continuous with this higher, arenaceous bed.

In New Jersey the formation makes its first appearance just south of Hainesville, where it occurs as a thin, sandy layer at the top of the Coeymans limestone. South of this locality, for some distance, it is not a conspicuous formation, it being too thin a bed and too heavily drift covered to afford noticeable exposures. Below Peter's Valley, however, it becomes more strongly developed, and is frequently met with. A good exposure of it may be seen in the side of the road crossing the Wallpack ridge at Wallpack Center. At one locality above Wallpack Center the formation contains numerous fossils, but they are all imperfect casts, and cannot be identified with any certainty, though most of them appear to be identical with species which occur in the cherty limestone, the basal member of the New Scotland beds. At Flatbrookville this sandstone occurs, and from the base of the formation specimens of *Gypidula galeatus* were collected, while beds lying above it contain a fauna characterized by *Spirifer macropleurus,* which indicates that at this locality the Stormville sandstone has replaced the lower, cherty limestone member of the New Scotland beds.

BECRAFT LIMESTONE.

In a preliminary report upon the formations of the Wallpack ridge in New Jersey† a hard, gray, cherty limestone, lying above the shaley member of the New Scotland beds, was included in that formation, being considered as a third, or higher, member of the New Scotland beds. Further study has led to the conclusion that this limestone represents, and is the southern continuation of, the Becraft limestone of the New York section. It is a very hard and resistant layer, and back of the Nearpass quarry bluff it forms a continuous outcrop for half a mile or more, and is frequently met with further south. The entire thickness of the formation has never been observed, but it is estimated as twenty feet, more or less.

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*Second Geol. Surv. Penn., Rep. G. 6, pp. 132, 133.

†Ann. Rep. State Geol. N. J. for 1899.

The fauna of the Becraft limestone is closely allied to that of the New Scotland beds, many species being common to the two formations, although some forms identified from one formation have not been observed in the other. Because of this conspicuous community of species in these two formations, their faunas have not been separated in the descriptive part of the present report, but are all described together.

Locality 2 A[31].—The only locality where the fossils of the Becraft limestone have been carefully collected is in the low ridge back of the Nearpass quarry bluff. Fossils are abundant in the formation, wherever it occurs, but they are always so firmly imbedded in the hard, cherty matrix that it is difficult to collect them. In the collections made from the Nearpass section the following species have been identified:

1. *Streptelasma strictum* Hall.
2. *Stropheodonta beckei* Hall.
3. *Stropheodonta* sp. undet.
4. *Strophonella punctulifera* (Con.).
5. *Leptæna rhomboidalis* (Wilck.).
6. *Rhipidomella oblata* (Hall).
7. *Schizophoria multistriata* (Hall).
8. *Uncinulus vellicatus* (Hall).
9. *Rhynchotrema formosum* (Hall).?

of some species. This is especially noticeable in the case of *Leptæna rhomboidalis,* which has not been a common species in the earlier Helderbergian faunas, but which, in the Becraft limestone, becomes especially abundant.

KINGSTON BEDS.

Lying above the Becraft limestone, and below the conspicuous trilobite bed at the base of the Oriskany formation, there is a series of strata which have nowhere been exposed. They are probably shaley beds, which are easily disintegrated, and become more or less deeply covered with *debris.* In the Nearpass section these beds occupy the interval between the outcrops of the resistant subjacent and superjacent beds, in a shallow depression and in the lower, drift-covered portion of the bluff, which is capped by the "trilobite bed." The thickness of the beds at this point is roughly estimated as about 80 feet.

No fossils have been collected from this formation, so that the only basis for the correlation of the beds is their stratigraphical position, which corresponds with that of the Kingston beds of the New York section. In Pennsylvania these same beds have been called the Stormville shales, by White.*

ORISKANY FORMATION.

Lying above the formation which has been referred to the Kingston beds there is a series of strata having an aggregate thickness estimated at about 170 feet. These beds are, for the most part, siliceous limestones, but at the summit of the formation in the southern half of the Wallpack ridge in New Jersey the higher beds are replaced by sandstones. With the southwestern extension of the formation into Pennsylvania the arenaceous facies becomes more and more conspicuous, the sandstones replacing lower and lower beds until the entire Oriskany formation is a sandstone continuous with the Stormville sandstone or conglomerate, which, in its turn, replaces higher and higher beds in its southwestern extension.†

The fauna of the Oriskany beds in New Jersey is not homogeneous throughout, and three well-defined faunal zones may be recognized, all of them being represented in the Nearpass section. The lowest of these life zones is especially characterized by *Dalmanites dentatus;* the second is characterized by *Orbiculoidea jervensis,* and the third by the great abundance of *Spirifer murchisoni,* although this species also occurs in both of the lower zones.

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*Second Geol. Surv. Penn., Rep. G. 6, p 131.

†Second Geol. Surv. Penn., Rep. G. 6, p. 133.

In the descriptive part of the present report the fauna of the *Dalmanites dentatus* zone has been treated as a unit, there being at least a doubt as to whether it should be included in the Oriskany. The faunas of the two higher zones, on the other hand, have been described all together, as it is believed that no one will question the Oriskany age of both. In the present discussion of the faunas, however, each of these faunal zones will be treated by itself, in order that its characteristics and relationships may be more easily discussed.

The Dalmanites dentatus Zone.

Locality 2 A^{33}.—In the Nearpass section the beds bearing the *Dalmanites dentatus* fauna form the crest of the high ridge to the northwest of the Nearpass quarry. They are a southern extension of the beds which form the crest of the ridge in New York State, east of Tri-States, which has been called "the trilobite ridge" by those who have collected in that region. The species of fossils which have been identified from this locality are as follows:

1. *Vermipora serpuloides* Hall.
2. *Orbiculoidea ampla* (Hall).

16. *Meristella princeps* Hall.
17. *Actinopteria textilis* (Hall).
18. *Megambonia parva* n. sp.
19. *Megambonia?* sp. undet.
20. *Goniophora* sp. undet.
21. *Platyostoma nearpassi* n. sp.
22. *Platyceras* 2 sp. undet.
23. *Loxonema jerseyensis* n. sp.
24. *Hyolithes centennialis* Barrett.
25. *Tentaculites acula* Hall.?
26. *Orthoceras* sp. undet.
27. *Homalonatus vanuxemi* Hall.
28. *Dalmanites dentatus* Barrett.
29. *Beyrichia* sp. undet.

Locality 53 A.—The beds bearing the *Dalmanites dentatus* fauna can be traced throughout nearly the entire length of the Walpack ridge in New Jersey, but they are less easily distinguished toward the southern part of the region. At Peter's Valley, opposite the residence of Mrs. Coss, the beds are well exposed and are highly fossiliferous, the following species having been identified from there:

1. *Schizocrania superincreta* Barrett.
2. *Pholidops* sp. undet.
3. *Stropheodonta magnifica* (Hall).
4. *Stropheodonta* sp. undet.
5. *Leptæna rhomboidalis* (Wilck.).
6. *Anoplia nucleata* Hall.
7. *Chonostrophia jervensis* Schuchert.
8. *Dalmanella subcarinata* Hall.
9. *Rensselæria subglobosa* n. sp.
10. *Spirifer murchisoni* Castel.
11. *Cyrtina rostrata* Hall.
12. *Meristella princeps* Hall.
13. *Actinopteria textilis* (Hall).
14. *Dalmanites dentatus* Barrett.
15. *Leperditia?* sp. undet.

Locality 71 C.—A little over three-fourths of a mile southwest of Wallpack Center the calcareous, trilobite beds are exposed, and the following species have been collected:

1. *Dalmanella subcarinata* (Hall).
2. *Rhynchotrema formosum* (Hall).

3. *Rensselæria subglobosa* n. sp.
4. *Megambonia parva* n. sp.
5. *Orthoceras* sp. undet.
6. *Homalonatus vanuxemi* Hall.
7. *Dalmanites dentatus* Barrett.

South of the last-described locality the trilobite bed has not been detected *in situ,* although some of the species of the fauna have been observed. The most characteristic species of the fauna, besides *Dalmanites dentatus,* are *Rensselæria subglobosa* and *Chonostrophia jervensis,* all three of these species having been originally described from this horizon in New Jersey, and being known nowhere else at present. The constitution of the fauna is peculiar and intersting, both Helderbergian and Oriskany species being associated in the same bed. Clarke* has considered these trilobite beds to be the upper portion of the Kingston beds, so placing them below the Helderberg-Oriskany boundary line. The presence in the fauna, however, of such characteristic Oriskany species as *Orbiculoidea ampla, Stropheodonta magnifica, Anoplia nucleata, Spirifer murchisoni* and *Cyrtina rostrata* seems to indicate the Oriskany age of the fauna, although the association with these species of a large number of Helderbergian forms emphasizes the low position of the fauna in the Oriskany. A careful study of the Helderberg and Oriskany faunas in New Jersey has brought out conspicuously the absence of any sharp dividing line between these two horizons, either of a stratigraphic or of a faunal nature. The faunal change in passing from the Coeymans limestone to the New Scotland beds is a much more pronounced one than that in passing from the Helderbergian to the Oriskany. This mingling

The Orbiculoidea jervensis Zone.

The total thickness of the siliceous limestone beds which bear the *Orbiculoidea jervensis* fauna are nowhere entirely exposed. The beds, however, are probably not of great thickness, the estimate being twenty feet, but this may be too great. But few outcrops have been observed, and the fauna has been detected only at intervals from the New York State line to about Hainesville. Beyond this point the fauna is either not differentiated from the general Oriskany fauna or the beds are so heavily drift covered as to escape observation.

Locality 2 A^{34}.—The only exposure of the *Orbiculoidea jervensis* beds detected in the Nearpass section is a very limited one on the Werden farm, just north of the Sanford Nearpass place, near a private road leading over the hill to the gravel pits. It was from here that the type specimens of *Orbiculoidea jervensis* were originally collected by Dr. Barrett. The following species have been identified from this locality:

1. *Orbiculoidea jervensis* (Barrett).
2. *Chonetes hudsonica* Clarke.
3. *Spirifer murchisoni* Castel.
4. *Beachia suessana* (Hall).

Locality 7 A.—An outcrop of this zone occurs in the first cross-road over the Wallpack ridge, south of the New York State line, about three miles from the line. The following species have been recognized from this point:

1. *Orbiculoidea jervensis* (Barrett).
2. *Chonetes hudsonica* Clarke.
3. *Spirifer murchisoni* Castel.
4. *Actinopteria* sp. undet.

Locality 9 A.—By far the best locality observed for collecting the fossils of the *Orbiculoidea jervensis* zone is along the edge of the woods just south of the second wagon road crossing the Wallpack ridge, about five miles from the New York State line. From this locality the following species have been identified:

1. *Trachypora oriskania* n. sp.
2. *Fenestella?* sp. undet.
3. *Orbiculoidea jervensis* (Barrett).
4. *Stropheodonta magnifica* Hall.
5. *Orthothetes* sp. undet.

6. *Chonetes hudsonica* Clarke.
7. *Rhipidomella oblata* Hall.
8. *Anoplia nucleata* Hall.
9. *Spirifer murchisoni* Castel.
10. *Cyrtina varia* Clarke.
11. *Metaplasia plicata* n. sp.
12. *Meristella lata* Hall.
13. *Rhynchonella breviplicata* n. sp.
14. *Anoplotheca flabellites* (Con.).
15. *Anoplotheca dichotoma* (Hall).
16. *Beachia suessana* (Hall).
17. *Actinopteria insignis* Clarke.
18. *Pterinea?* sp. undet.
19. *Platyostoma desmatum* (Clarke).
20. *Platyceras* sp. undet.
21. *Orthoceras* sp. undet.
22. *Tentaculites elongatus* Hall.
23. *Dalmanites* sp. undet.
24. *Phacops* sp. undet.

Locality 25 E.—About one-half mile southwest of Hainesville, an outcrop of the beds bearing the *Orbiculoidea jervensis* fauna has been observed, from which the following species of fossils have been secured:

1. *Orbiculoidea jervensis* (Barrett).
2. *Stropheodonta magnifica* Hall.
3. *Beachia suessana* (Hall).

Although the fauna of this zone still contains an element of the and this fauna from New Jersey is close, the one species, *Orbiculoidea jervensis,* which is pre-eminently the most conspicuous member of the fauna in New Jersey, has not been recognized by Clarke from Becraft mountain.

The Spirifer murchisoni Zone.

The larger proportion of the Oriskany beds in New Jersey bears the fauna which is chiefly characterized by *Spirifer murchisoni,* a species which is also present in the earlier Oriskany faunas, but which only attains a conspicuous position in the fauna of these higher beds. The strata containing this fauna are, for the most part, siliceous limestones, not especially different from those which bear the *Orbiculoidea jervensis* fauna, but the fauna itself resembles that of the arenaceous, Oriskany beds of New York more closely than the calcareous facies of Becraft mountain. In the southern portion of the Delaware valley region of New Jersey the upper portion of these siliceous limestones is replaced by sandstone, which does not essentially differ, in its lithologic characters, from the typical Oriskany sandstone of New York, and yet, so far as has been observed in this State, there is no essential change in the fauna of these sandstone beds from that of the calcareous beds immediately beneath. The fauna differs in some respects from that of the typical Oriskany sandstone of New York, one of the most conspicuous differences being in the rarity of *Spirifer arenosus,* which, in New York, is abundantly represented in the Oriskany sandstone. In these New Jersey beds fragments of trilobites may usually be detected, as well as an occasional coral, these being fossils which are among the rarest forms in the New York Oriskany sandstone.

Locality 3 A.—In the Nearpass section the beds bearing the *Spirifer murchisoni* fauna may be best studied on the Werden farm, north of the Sanford Nearpass place. The beds at this locality are a northward extension of 2 A^{35}, which is too much drift covered to offer an opportunity for making collections. The following species have been identified:

1. *Stropheodonta magnifica* Hall.
2. *Camarotœchia barrandii* (Hall).
3. *Eatonia peculiaris* (Con.).
4. *Spirifer murchisoni* Castel.
5. *Cyrtina varia* Clarke.

6. *Metaplasia plicata* n. sp.
7. *Anoplotheca flabellites* (Con.).
8. *Meristella lata* (Hall).
9. *Actinopteria textilis* var. *arenaria* (Hall).
10. *Platyostoma ventricosa* Con.
11. *Tentaculites elongatus* Hall.
12. *Dalmanites* sp. undet.

Locality 15 D.—In the roadside, a little less than one mile south of Brick House, an outcrop of these siliceous limestones may be seen. Fossils are not abundant, only the two following species having been recognized:

1. *Spirifer murchisoni* Castel.
2. *Actinopteria* sp. undet.

Locality 25 F.—From a locality one and one-half miles directly north of Layton the following species were collected:

1. *Chonostrophia complanata* (Hall).
2. *Spirifer murchisoni* Castel.
3. *Meristella lata* (Hall).

Locality 37 A.—Three-fourths of a mile west of Layton, on the road to Dingman's, one of the best exposures of these siliceous limestones may be studied. The beds outcrop along the roadside, and they have been excavated more or less in building the road. This is one of the best localities for collecting the fossils of the horizon, and the following species have been recognized:

Locality 37 C.—This locality is three-fourths of a mile north of Peter's Valley, in the woods, above the large spring. The stratum from which the fossils were obtained is a sandstone bed, near the top of the Oriskany formation. The fossils are not well preserved, but the following species have been identified:

1. *Leptæna rhomboidalis* var. *ventricosa* (Hall).
2. *Spirifer murchisoni* Castel.
3. *Anoplotheca flabellites* (Con.).
4. *Meristella lata* (Hall).

Locality 53 B.—At Peter's Valley, on the hill opposite the residence of Mrs. Coss, weathered masses of the siliceous, Oriskany limestone are strewn over the surface, and the hill itself is doubtlessly constituted of this rock. Some of these loose masses are highly fossiliferous, and the following species have been identified:

1. *Edriocrinus sacculus* Hall.
2. *Pholidops ovata* Hall.
3. *Stropheodonta magnifica* Hall.
4. *Leptæna rhomboidalis* var. *ventricosa* (Hall).
5. *Hipparionyx proximus* (Van.).
6. *Chonostrophia complanata* (Hall).
7. *Eatonia peculiaris* (Con.).
8. *Beachia suessana* (Hall).
9. *Spirifer arenosus* (Con.).
10. *Spirifer murchisoni* Castel.
11. *Metaplasia plicata* n. sp.
12. *Anoplotheca flabellites* (Con.).
13. *Meristella lata* (Hall).
14. *Megambonia bellistriata* Hall.
15. *Platyostoma ventricosa* Con.
16. *Platyceras tortuosum* Hall.
17. *Tentaculites elongatus* Hall.

Locality 70 A.—A short distance southwest of the cross-roads, one and one-half miles southwest of Wallpack Center, the following species were collected from these siliceous limestone beds of the Oriskany:

1. *Pholidops arenaria* Hall.
2. *Anoplotheca flabellites* (Con.).
3. *Actinopteria textilis* var. *arenaria* (Hall).
4. *Platyostoma ventricosa* Con.

Locality 88 A.—In the hillside, about one-half mile due east of Flatbrookville, the siliceous limestone, Oriskany beds are exposed, and above them the sandstone facies of the formation. From the calcareous beds at this locality the following species have been identified:

1. *Favosites* sp. undet.
2. *Bryozoa* several undet. sp.
3. *Pholidops ovata* Hall.
4. *Stropheodonta magnifica* Hall.
5. *Eatonia peculiaris* (Con.).
6. *Spirifer murchisoni* Castel.
7. *Metaplasia plicata* n. sp.
8. *Anoplotheca flabellites* (Con.).
9. *Platyostoma ventricosa* Con.
10. *Tentaculites elongatus* Hall.
11. *Dalmanites* sp. undet.

ESOPUS GRIT.

This is one of the most persistent formations in the Delaware valley region of New Jersey, and forms the crest of the Wallpack ridge throughout the greater part of its extent in the State. It is a nearly black, gritty, resistant rock, in which cleavage is frequently developed to a high degree. Usually it is difficult to distinguish the bedding planes, because of the slaty cleavage, but when they can be recognized, the fucoid "candagalli" markings are often more or less clearly to be seen. Aside from these indefinite, supposed fucoid or sea-weed markings, fossils are exceedingly rare in the whole formation. A single, imperfect specimen of an inarticulate brachiopod, probably

ONONDAGA LIMESTONE.

The Onondaga (Corniferous) limestone proper is restricted to the Delaware valley region of New Jersey, although beds of similar age are represented in the Green Pond region. The formation lies above the Esopus grit, and covers the greater portion of the northwestern slope of the Wallpack ridge. Towards its base the formation is somewhat shaley, and there is apparently a rather gradual transition from the subjacent Esopus grit to the Onondaga limestone. The limestone is a hard, regularly-bedded rock, the beds ranging in thickness from three inches to a foot. Some of them contain large quantities of chert, which give to their weathered surfaces an extremely rough and jagged appearance. Fossils are not abundant in this formation, and those that are present are usually too firmly imbedded in the matrix to be satisfactorily studied.

Locality 2 B.—Along the river road, about two and one-half miles below Tri-States, New York, there are several outcropping ledges of this formation, from which the following species of fossils were collected:

1. *Stropheodonta perplana* (Con.).
2. *Atrypa reticularis* (Linn.).
3. *Loxonema* sp. undet.

Locality 37 D.—In a field about three-fourths of a mile northwest of Peter's Valley there are good exposures of the Onondaga limestone, in which some fossils are present. Most of these are corals, too firmly imbedded in the matrix to be collected, and some crinoid columns; the only species of brachiopod observed was *Leptæna rhomboidalis.*

Locality 52 A.—One of the best fossil localities which has been observed in the Onondaga limestone of New Jersey is at the side of the river road, one and one-half miles southwest of Peter's Valley. The following species have been identified from there:

1. *Fenestella?* sp. undet.
2. *Stropheodonta perplana* (Con.).
3. *Chonetes arcuatus* Hall.
4. *Rhipidomella vanuxemi* (Hall).
5. *Atrypa reticularis* (Linn.).
6. *Reticularia fimbriata* (Con.).
7. *Anoplotheca concava* (Hall).

Locality 70 B.—Another locality where several species of fossils were secured from this formation is at the side of the river road, four miles northeast of Flatbrookville. The following species have been identified from there:

1. *Zaphrentis* sp. undet.
2. *Lingula* sp. undet.
3. *Leptæna rhomboidalis* (Wilck).
4. *Orthothetes pandora* (Bill.).
5. *Rhipidomella vanuxemi* (Hall).
6. *Atrypa reticularis* (Linn.).
7. *Spirifer* sp. cf. *S. varicosus* Hall.
8. *Anoplotheca concava* (Hall).
9. *Platyceras* sp. undet.

Locality 89 B.—On the river bank, two miles northeast of Flatbrookville, the following species were collected from the Onondaga limestone:

1. *Orthothetes pandora* (Bill.).
2. *Anoplotheca acutiplicata* (Con.).

Locality 88 B.—In an excavation in the lower, shaley beds of the Onondaga limestone, one-half mile northwest of Flatbrookville, on the river road, several imperfect specimens of *Anoplotheca acutiplicata* were collected.

The entire recognized fauna of the Onondaga limestone in New Jersey is a small one, and it does not afford sufficient characteristics for close correlation. There are none of the recognized species, however, which do not commonly occur in the Onondaga limestone in its more typical localities in New York, and this, together with its

The fossils of the formation are never well preserved, and in most localities they are rarely met with, only two localities having afforded material sufficiently well preserved for identification.

Locality 87 B.—The fossils from this locality were collected on top of the ridge west of the southern portion of Greenwood lake. They occur in the upper portion of the formation, and the following species have been identified:

1. *Orthothetes pandora* (Bill).
2. *Chonetes arcuata* Hall.
3. *Amphigenia elongata* (Van.).
4. *Spirifer macrothyris* Hall.
5. *Cyrtina hamiltonensis* Hall.
6. *Anoplotheca acutiplicata* (Con.).
7. *Actinopteria decussata* Hall.

Locality 145 A.—At Newfoundland, about 300 yards east of Chamberlain's Hotel, the lower beds of this formation outcrop in a field. Fossils occur somewhat commonly, but, on account of the matrix in which they are imbedded, it is exceedingly difficult to make a arge collection of them. The following species have been identified:

1. *Zaphrentis* sp. undet.
2. *Stropheodonta inequiradiata* Hall.
3. *Schizophoria* sp. cf. *S. striatula* (Schl.).
4. *Amphigenia elongata* (Van.).
5. *Spirifer macrothyris* Hall.
6. *Spirifer* sp. undet.
7. *Cyrtina hamiltonensis* Hall.
8. *Pterinea flabella* (Con.).

The composition of the fauna of the Newfoundland grit at both of these localities is essentially that of the Onondaga limestone of the New York section. In a former preliminary report upon the Green Pond mountain region* it was stated that the fauna contained a mixture of Oriskany and Onondaga species, but a more careful study of the material has failed to establish a single Oriskany species in the fauna. The specimens formerly identified provisionally as *Spirifer arenosus* and *Spirifer murchisoni* (= *S. arrectus*) prove not to be these species. The presence of horn corals in some abundance is another character of the fauna which tends to disprove its Oriskany relationships. Two species in the fauna, *Pterinea flabella* and *Actinop-*

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*Ann. Rep. N. J. State Geol. for 1901, p. 20.

teria decussata, are, normally, members of the fauna of the Hamilton beds in New York. The deposition of this formation was, without doubt, essentially contemporaneous with the deposition of the Onondaga limestone in the Delaware valley and in New York, it being composed of the arenaceous shore deposits, while the limestone was deposited in somewhat deeper water, at a distance from the shore line, in the same basin of sedimentation.

MONROE SHALES.

This formation, like the last, is restricted in its distribution to the Green Pond mountain region. It consists of a series of more or less siliceous or argillaceous shales of a dark color, which have been crushed and sheared to such an extent that the lines of bedding and the organic remains are frequently obliterated. Fossils never occur in abundance, and those which are found are almost always badly distorted and imperfectly preserved. The estimated thickness of the formation is from 700 to 1,000 feet.

Locality 87 A.—This locality lies one and one-half miles from the southern extremity of Greenwood lake, at the side of the road along the west shore of the lake. The following species have been identified:

1. *Orthothetes chemungensis* (Con.).
2. *Chonetes* sp. undet.
3. *Tropidoleptus carinatus* (Con.).?
4. *Ambocœlia umbonata* (Con.).
5. *Anoplotheca acutiplicata* (Con.).?

Locality 188 A.—Near the roadside at Sylvester's Corners, Woodstock, five and one-half miles southwest of Newfoundland, the following species were collected:

1. *Fenestella?* sp. undet.
2. *Chonetes* sp. undet.
3. *Camarotœchia* sp. undet.
4. *Homalonotus dekayi* (Green).?

Although the entire known fauna of the Monroe shales, as indicated in the foregoing lists, is not a large one, its characteristics are undoubtedly those of the Hamilton fauna of the New York section. *Tropidoleptus carinatus* is one of the most characteristic Hamilton species, and its identification in New Jersey can be made without the least doubt. All of the other species recognized are also Hamilton forms, with the exception of *Anoplotheca acutiplicata* and *Dalmanites anchiops,* which have been originally described from the fauna of the Onondaga limestone.

BELLVALE FLAGS.

This formation is scarcely more than a continuation of the last. The beds are more arenaceous, but there is a gradual gradation from the shale beds below into the dark-colored grits and flagstones. The average thickness of the formation is about 1,800 feet.

Locality 144 A.—Fossils do not commonly occur in the Bellvale flags, but from the material which has been excavated to form the outlet of the Oak Ridge reservoir, near Newfoundland, the following species have been collected:

1. Crinoid stems.
2. *Tropidoleptus carinatus* (Con.).
3. *Spirifer audaculus* (Con).?
4. *Palæoneilo emarginata* (Con.).
5. *Paracyclus elliptica* Hall.?
6. *Grammysia* sp. undet.
7. *Cyrtonella mitella* Hall.
8. *Strophostylus* sp. undet.

These species constitute the known fauna of the Bellvale flags in New Jersey. They are all Hamilton forms, with none of the characteristic Chemung species of the New York faunas.

SKUNNEMUNK CONGLOMERATE.

This conglomerate forms the great mass of the Bearfort mountain in New Jersey, and also of Bellvale mountain, which is its northward continuation in New York. Skunnemunk mountain, lying still further north in New York State, is another great mass of this conglomerate, and has given rise to the name of the formation. The typical beds of the formation are a coarse, purple-red, massive conglomerate, the pebbles of which are sometimes six or seven inches in diameter. Beds of red sandstone alternate more or less frequently with the conglomerate, and there are many gradations between the two. No fossils have been detected in the formation, and, as it is the youngest paleozoic formation in New Jersey, its age can only be determined by the underlying beds, which are Hamilton in age. It may be correlated with the upper Devonian of the New York section, but whether it is the exact equivalent of the Chemung-Catskill cannot be determined.

PART II.

Descriptive Paleontology.

CHAPTER VI.

FAUNAS OF CAMBRIAN AGE.

The Cambrian faunas of New Jersey are restricted to certain layers of the Hardyston quartzite and the Kittatinny limestone. Nowhere in these formations are the fossils abundant, while usually no traces of organisms can be detected, and those that have been found are always fragmentary. In the uppermost beds of the Kittatinny limestone the Cambrian species disappear, and are replaced by a fauna of Beekmantown (=Calciferous) type, which is usually considered as of early Ordovician age.

The species of the Cambrian faunas will all be considered together, although the different localities which have afforded fossils are doubtless of somewhat different horizons. The only fossil horizon of Cambrian age that can be definitely placed in relation to the others is the *Olenellus* bearing bed of the Hardyston quartzite, which is always, wherever it has been found, near the base of the sedimentary series in New Jersey, and is at a lower horizon than any of the other beds carrying Cambrian fossils. At this horizon, however, *Olenellus thompsoni* is the only species which has been identified, although the fragments of some other trilobites may be present, as well as some more or less indefinite worm burrows.

PROTOZOA.

FORAMINIFERA.

Plate I., Figs. 1-2.

In the Cambrian fauna at Newton some more or less subglobular bodies, whose diameters range from 4 to 6 mm., have been observed, which are quite plainly organic in their nature. In some cases these bodies have a slightly constricted, encircling band, nearer to one extremity than to the other. It is difficult to determine with certainty what these objects have been, but they suggest the shells of Foraminifera.

MOLLUSCOIDEA.

BRACHIOPODA.

LINGULELLA STONEANA Whitf.

Plate I., Fig. 6.

1882. *Lingulella stoneana* Whitf., Geol. Wis., vol. IV., p. 344, pl. 27, figs. 6–7.

Description.—Shell subovate to subpentagonal in outline, longer than wide, the beak rather blunt. The surface of both valves marked by concentric lines of growth, which are usually crowded and much more conspicuous near the margin, and also by fine, sharply-elevated, somewhat wavy ridges, which extend directly across the shell transversely from margin to margin, being nearly at right angles to the concentric growth lines at the margin, and becoming parallel with them along the medium line of the shell. The transverse lines become obsolete towards the anterior portion of the shell, but posteriorly about four or five of them occupy the space of 1 mm. In one specimen, near at the medium line of the shell. In Whitfield's illustration, however, the lines are shown to pass more directly across the shell, as they do in the New Jersey specimens.

ORTHIS NEWTONENSIS n. sp.

Plate I., Figs. 3–5.

Description.—Shell biconvex, subquadrangular to subelliptical in outline, the hinge-line a little shorter than the greatest width of the shell. Pedicle valve regularly convex, greatest convexity near the beak in the smaller shells, but further towards the front in the larger individuals; cardinal area of moderate height, flat, sloping backward from the hinge-line at an angle of about 45°. Internally the pedicle valve has a more or less prominent, concave, muscular impression, about one-fourth as wide as the shell and about as long as wide; it is a little elevated above the floor of the valve and is bounded laterally toward the beak by the short, dental plates. In some of the older shells a narrow, mesial, elevated ridge extends forward from the anterior margin of the muscular impression, becoming broader toward the front, but dying out before reaching the margin of the shell. The brachial valve is less convex than the pedicle; it is depressed along the median line in a shallow, ill-defined, broadly-rounded sinus, which becomes more conspicuous as it approaches the anterior margin. Internally the muscular impression is much smaller than that of the pedicle valve; it is elevated above the floor of the valve and resembles the impression of the other valve, but is marked by a slight, median ridge. The surface of both valves is marked by faint, radiating lines, which are visible on the internal casts, but are too imperfectly preserved to properly exhibit their characters. There are apparently about thirty or forty costæ upon a shell of average size, some of which are coarser, with two or three finer ones between.

The dimensions of one of the best-preserved pedicle valves are: length, 7 mm.; width, 8 mm.; convexity, 2 mm.

Remarks.—This is the commonest species in the fauna at Newton, and occurs, also, at several other localities. It is apparently one of the Orthidæ, but its generic position is not so easily determined. In general form the shell resembles some members of the genus *Dalmanella* more closely than any others, but the muscular impressions are not at all as in that genus. The muscular impression of the pedicle valve has some more or less remote resemblance to that of members of the typical genus *Orthis*, but the impression in the brachial valve is quite different. Doubtless there are other similar Cambrian Orthids, but for the present, until all the Cambrian brachiopods have been thoroughly investigated, the species may be placed provisionally in the genus *Orthis*.

ARTHROPODA.

TRILOBITA.

MICRODISCUS? sp. undet.

Plate III., Fig. 11.

A single specimen, too imperfect for identification or description, appears to belong either to *Microdiscus* or *Agnostus*. The specimen is probably a head, and is nearly semi-circular in outline, being proportionately much broader than is usually the case with members of the genus *Agnostus*, for which reason it is placed provisionally in *Microdiscus*.

OLENELLUS THOMPSONI (Hall).

Plate II., Figs. 9-10.

is situated about two-fifths the length of the glabella from the anterior end, the others being arranged nearly equidistantly from each other; the posterior or occipital furrow is usually the most pronounced, sometimes being almost continuous across the glabella. The eye-lobes are level with the glabella and are separated from it by the rather broad, dorsal furrow. The eyes are elongate, narrowly crescentic in outline, reaching nearly to the posterior margin of the head, with their anterior extremities opposite the anterior, lateral lobes of the glabella. The cheeks slope away from the glabella and the eyes, to the laterial and anterior margins, with a gentle convexity at first, but becoming slightly concave near the margin. The margin bordered by a narrow, scarcely-elevated rim, which is produced at the genal angles into short, rounded spines. Thorax and pygidium not seen.

The dimensions of an average specimen are: length of head along axis, 8 mm.; width of head, 13.5 mm. The length of one of the largest heads observed is 22 mm.

Remarks.—This species has been found most abundantly in the Hardyston quartzite near Franklin Furnace, but it also occurs in the same formation, near Andover, near Oxford Furnace and at Washington, as well as in the Green Pond region, northeast of Newfoundland. No complete individuals have been seen, the portions found usually being more or less perfect heads. Associated with the heads are the fragments of thorasic segments, which doubtless belong to the same species, but no pygidium or posterior spine has been observed. Because of our lack of knowledge of the posterior extremity of this trilobite, it is not possible to identify it with absolute certainty as *O. thompsoni*, but the characters of the head seem to be identical with that species, although the specimens are much smaller, as a rule, than the more typical representatives of the species from Vermont.

OLENELLUS? sp. undet.

Plate III., Fig. 8.

Among the specimens collected at Newton is a single imperfect free cheek of a trilobite, with an exceedingly elongate eye-lobe, which strongly suggests the genus *Olenellus*. It resembles more closely the similar cheeks of undoubted *Olenellus* from the Hardyston quartzite at Franklin Furnace than any other trilobite. If in the future mo perfect specimens of this trilobite should be secured, and its identi cation as *Olenellus* should be confirmed, this association of the tw genera, *Olenellus* and *Dikelocephalus,* in the same fauna would be remarkable occurrence.

PTYCHOPARIA BLAIRI n. sp.

Plate I., Figs. 10–13.

Description.—Glabella small, tumid, longer than wide, the sid subparallel, the front regularly rounded and reaching to the anteri margin of the head. It is marked by two pairs of well-defined, later furrows, which divide it into three nearly equal parts; the anterio pair of furrows are straight and each one extends about one-third th distance across the glabella; the second pair are straight at first an then bend backward somewhat abruptly, towards the occipital furrow in length they about equal the anterior pair. The occipital furro is well defined and is continuous across the glabella; the occipita segment is rather broad, with the posterior margin parallel wit the occipital furrow. The fixed cheeks are only imperfectly known, but are apparently strongly depressed below the glabella, are rather broad behind, becoming narrower anteriorily, and are not continuous around the anterior extremity of the glabella. Free cheeks unknown. Pygidium minute, strongly convex, semi-circular in outline; the axis highly elevated above the pluræ, occupying more than one-third the total width, and tapering to the rather sharply-rounded posterior extremity, which reaches to the posterior margin of the pygidium; divided into five segments by four transverse furrows, which become

PTYCHOPARIA NEWTONENSIS n. sp.

Plate III., Fig. 10.

Description.—Glabella tumid, subquadrangular in outline, the lateral margins parallel, broadly rounded anteriorly, slightly contracted posteriorly just in front of the occipital furrow; marked by two pairs of lateral furrows, of which the anterior pair is near the centre of the glabella; all the furrows curve backward as they approach the median line of the glabella, and extend about one-third of the distance across it. Occipital furrow well defined; occipital segment with parallel margins, a little narrower than the width of the glabella, Fixed cheeks broad behind, becoming much narrower in front. Palpebral lobes situated at about the middle of the total length of the head. Anterior border not preserved, but apparently rather broad, connecting the fixed cheeks around .the front of the glabella. Free cheeks, thorax and pygidium unknown.

The approximate dimensions of the type specimen are: length, 3.5 mm.; width, 4.75 mm.

PTYCHOPARIA CALCIFERA Walcott.?

Plate I., Fig. 14.

1879. *Conocephalites calciferus* Walc., 32d Rep. N. Y. State Mus. Nat. Hist., p. 129.

1886. *Ptychoparia calcifera* Walc., Bull. U. S. Geol. Surv., No. 30, p. 21.

Among the specimens from near Blairstown is a single, fragmentary individual, which may belong to *Ptychoparia calcifera* Walc., originally described from the upper Cambrian of Saratoga county, New York. Nothing is preserved except the occipital segment of the head, which is produced into a long spine as in that species.

PTYCHOPARIA? sp. undet.

Plate III., Fig. 13.

A single specimen from Newton, which is different from any of th others in the collection, but is too imperfect for identification, may b provisionally referred to the genus *Ptychoparia*.

The glabella is subelliptical in outline; glabellar furrows obsolete occipital furrow well defined; axial portion of occipital segmen narrower than the width of the glabella in front. Fixed cheeks imperfectly preserved, rather broad behind, becoming narrower anteriorly and passing into the frontal limb; palpebral lobes small, apparently placed nearly opposite the anterior end of the glabella. Fixed cheeks thorax and pygidium unknown.

The approximate dimensions of the specimen are: length, 3.5 mm.; width, 5 mm.

PTYCHOPARIA sp. undet.

Plate III., Fig. 9.

This specimen from Newton cannot be identified with any of the described species of the genus *Ptychoparia*, to which it apparently belongs, but it is altogether too imperfectly preserved to be used as the type of a new species.

The approximate dimensions of the specimen are: length, 8.5 mm.; width, 13 mm.

rather broad and shallow; occipital segment produced posteriorly at the centre, into a short, blunt protuberance, scarcely to be called a spine, and narrowing towards the sides. Dorsal furrow shallow, but fairly well defined. Fixed cheeks about one-half as wide as the glabella at the posterior margin of the head, narrowing anteriorly and merging into the frontal limb. Palpebral lobes small, situated a little anterior to the middle of the head. The frontal limb one-fourth to one-sixth the length of the head, curved downward to the anterior borders, without any marginal furrow. Free cheeks convex, irregularly triangular in outline, without a marginal furrow or border, with a short, rounded, genal spine. Pygidium sub-semi-circular in outline, strongly convex, marginal furrow slight or entirely obsolete; axial lobe occupying nearly one-half the entire width and reaching to the posterior margin, divided by four transverse furrows, of which the two anterior ones are much the stronger; pluræ crossed by two furrows corresponding to the two anterior ones of the axial lobe.

The approximate dimensions of a large head are: length, 14.5 mm.; width, 24 mm.

Remarks.—This species was first described by Walcott from near Saratoga Springs, New York. In the original description mention is made of indistinct, glabellar furrows, but they are not shown in the illustration accompanying the description, and are wholly absent from the New Jersey specimens. The pygidia associated with the New Jersey specimens does not entirely agree with the description of that portion of the species as it occurs at Saratoga, the transverse furrows being much less conspicuous. Notwithstanding these differences, the specific identity of the specimens from the two localities can scarcely be questioned. Most of the specimens observed are smaller than the one illustrated, some of them being less than 5 mm. in length.

SOLENOPLEURA JERSEYENSIS Weller.

Plate II., Figs. 1–8.

1899. *Liostracus? jerseyensis* Weller, Geol. Surv. N. J., Ann. Rep. of State Geol. for 1899, p. 51, pl. 1, figs. 1–8.

Description.—Glabella large and prominent, longer than wide, subquadrangular or subelliptical in outline, marked by two pairs of faint, lateral furrows, of which the anterior pair are transverse in their direction, each one extending about one-third the width of the glabella, and are sometimes nearly or quite obsolete; the posterior pair are always present, although sometimes nearly obsolete, arching backwards towards the occipital furrow. Occipital segment separated from the glabella by a deep and rather wide occipital furrow, produced posteriorly in a broadly-triangular spine, which is slightly attenuate towards the extremity. Fixed cheeks broad behind, somewhat convex, bending downward to the lateral margins; the frontal limb bending upward and forming a rather conspicuous, elevated rim in front. Facial sutures slightly curved inward anteriorly and bending outward posteriorly to the posterior margin, their direction being somewhat sigmoidal. Position and form of pelpebral lobes not definitely shown in the specimens. Pygidium small, much broader than long, obtusely subangular at its posterior extremity; axis prominent and strongly convex, consisting of five segments, with indications of a sixth one posteriorly, its posterior extremity abruptly rounded and reaching to the posterior margin of the pygidium; pluræ nearly flat, with a slight marginal groove, divided into five segments.

The approximate dimensions of the largest cranidium observed are: length, 6.2 mm.; width, 7.5 mm.

Remarks.—The true generic position of this species must remain in doubt until a complete revision of the genera of American Cambrian trilobites has been made. When first described the species was referred to *Liostracus*. This generic reference, however, was evidently wrong, and is now changed to *Solenopleura,* which may also eventually prove to be an incorrect reference.

lobes prominent, situated nearly opposite the anterior extremity of the glabella. Free cheeks, thorax and pygidium unknown.

The approximate dimensions of the type specimen are: length, 3.25 mm.; width, 4.5 mm.

Remarks.—This species is placed in the genus *Anomocare* on account of its broad frontal limb, a character which it shares with members of that genus.

DIKELOCEPHALUS NEWTONENSIS n. sp.

Plate III., Figs. 1–7.

Description.—Head convex, sub-semi-circular in outline. Cranidium irregularly subquadrangular in outline. Glabella moderately convex, longer than wide, subquadrangular in outline, the anterior extremity somewhat truncated, the lateral margins converging anteriorly; crossed by three transverse furrows, the first of which is very faint, but extends continuously across the glabella, its lateral extremities directed slightly forward, so that the furrow describes the arc of a circle; the second furrow opposite the palpebral lobes, parallel with the first, but much more deeply impressed; the third, or occipital, furrow is usually nearly straight, but sometimes with its lateral extremities directed slightly forward, about as deeply impressed as the second furrow; occipital segment depressed, convex, not rising higher than the glabella in front of it. Fixed cheeks less than one-half the width of the glabella, longitudinally convex, moderately depressed below the level of the glabella opposite the palpebral lobes, but more deeply depressed, both anterior and posterior, to this point. Palpebral lobes situated at about the middle of the length of the head. Frontal limb rather narrow, convex at the margin, separated from the anterior extremity of the glabella by a shallow, rounded groove. Free cheeks large, with long genal spines, which are frequently broken off; convex toward the eyes, with a convex marginal border separated from the inner portion of the cheek by a rather broad, concave depression. Pygidium subsemi-circular in outline, its margin entire, about one and one-half times as wide as long; axis prominent, especially posteriorly, tapering gradually to the somewhat sharply-rounded posterior end, crossed by five transverse furrows, which become more and more nearly obsolete posteriorly;

pluræ convex near the axis, but becoming flattened or broadly concave near the margin, with five, or, in the larger specimens, six, distinct grooved segments.

Remarks.—This is by far the commonest trilobite in the fauna at Newton, it being represented by fragments of a hundred or more individuals in the collection. These vary greatly in size, the smallest pygidium being not over 4 mm. in length, while the largest one observed, when complete, could not have been less than 30 mm. in length. The fragments of heads which have been observed also indicate a great variation in size; several fragments which, however, cannot be certainly determined as belonging to this species because of their imperfection, must have been portions of a trilobite head which, when complete, could not have been less than 50 mm. in breadth. All of these fragments of both heads and pygidia which are perfectly enough preserved for generic identification seem to belong to a single species.

Among the free cheeks observed, a considerable variation in the length of the genal spine is exhibited. The longer spines observed must have been equal to the length of the heads of which they were a part, and are extended into a very slender point posteriorly. The shorter spines have blunter, rounded points, and may simply indicate that the terminal portion has been broken away.

The species most closely resembles *D. pepinensis* Owen, from the Potsdam sandstone of Wisconsin, but differs from that species, especially in the pygidium, which, in *D. pepinensis,* is nearly semi-elliptical in outline, with a much more pointed axial lobe. The species differs from *D. hartii* Walc., described from the upper Cambrian limestone

CHAPTER VII.

FAUNAS OF ORDOVICIAN AGE.

The Ordovician faunas in New Jersey represent two distinct horizons, and the strata containing them are separated by a conspicuous physical break. The oldest Ordovician fauna represents the Beekmantown (= Calciferous) stage of the New York series, and occurs in the uppermost beds of the Kittatinny limestone, with no apparent physical break separating the strata from those bearing a Cambrian fauna. This fauna has been found at but a single locality—near Columbia.

The younger Ordovician fauna represents, in general, the Trenton stage of the New York series, and occurs in strata which lie unconformably upon the Kittatinny limestone, with a basal conglomerate between them. The limestones bearing the Trenton fauna have a wide distribution through the Kittatinny valley, in the northwestern portion of the State, and are usually more or less fossiliferous, although the fossils are frequently poorly preserved.

These two Ordovician faunas will be described separately, the first one which occurs in the upper strata of the Kittatinny limestone being the older.

DESCRIPTION OF SPECIES IN THE BEEKMANTOWN FAUNA.

MOLLUSCOIDEA.

BRACHIOPODA.

DALMANELLA WEMPLEI Cleland.

Plate IV., Figs. 10–12.

1900. *Dalmanella* (*Orthis*) *wemplei* Cleland, Bull. Am. Pal., No. 13, p. 17, pl. 17, figs. 10–13.

Description.—Shell small, subquadrangular or subelliptical in outline, a little wider than long, hinge-line a trifle shorter than the greatest width, cardinal extremities angular or a little rounded. Pedicle valve strongly convex, the highest point being posterior to the middle; beak elevated, projecting beyond the hinge-line; cardinal area high, slightly arched. Brachial valve less convex than the pedicle, with a mesial flattening, which sometimes becomes a shallow sinus towards the front. Surface of each valve marked by from ten to sixteen stronger, radiating costæ, with finer ones between.

The dimensions of the largest specimen observed, a brachial valve, are: length, 6 mm.; width, 8.5 mm. A smaller pedicle valve measures: length, 5 mm.; width, 5.5 mm.

it is quite possible that the two species should be considered as the same, but the New Jersey specimens seem to differ from that species in being less nearly subcircular and in having a proportionally longer hinge-line.

This species occurs most abundantly in a stratum a few feet above that containing *Illænurus columbiana,* where it is not associated with any other species, except a minute, coiled shell, a single, imperfect specimen of which has been observed.

DALMANELLA ELECTRA (Bill.).

Plate IV., Fig. 13.

1862. *Orthis electra* Billings, Pal. Foss., vol. I., p. 79, fig. 72.

Description.—Shell wider than long, subquadrangular or subelliptical in outline, the hinge-line a little shorter than the greatest width, cardinal extremities angular. Pedicle valve moderately convex on the umbo, slightly flattened towards the cardinal extremities; the beak projecting somewhat beyond the cardinal margin; cardinal area narrow, concave above. Brachial valve not seen. Surface marked by about fifty fine, subequal, radiating costæ, which increase by bifurcation.

The dimensions of a nearly perfect pedicle valve are: length, 5.75 mm.; width, 7 mm.

Remarks.—This species is not so abundant as the last, and the only specimens observed occur in the bed with *Illænurus,* near Columbia. The species may be distinguished from *D. wemplei* by its finer striæ, which do not alternate in size, and by its less convex pedicle valve, which is slightly flattened toward the cardinal angles.

SYNTROPHIA LATERALIS (Whitf.).

Plate IV., Figs. 14–15.

1886. *Triplesia lateralis* Whitfield, Bull. Am. Mus. Nat. Hist., vol. I., p. 303, pl. 24, figs. 9–11.

Description.—Shell subelliptical in outline, hinge-line about two-thirds the greatest width, cardinal extremities broadly rounded. Pedicle valve moderately convex, most prominent on the umbo, slightly flattened toward the cardinal angles; beak rather blunt, projecting beyond the cardinal margin, slightly incurved; mesial sinus broad, shallow and ill-defined, not reaching to the beak. On some exfoliated specimens a dark line, representing the median septum, may be detected extending forward from the beak for several millimeters. Surface marked by fine, concentric lines of growth. Brachial valve not seen.

The dimensions of an average specimen are: length, 7.5 mm.; width, 11 mm.

Remarks.—None of the New Jersey specimens of this species are very perfectly preserved, and they differ in some minor respects from Whitfield's illustrations of the types of the species from Fort Cassin, but there can scarcely be a doubt as to the identity of the shells from the two localities. The New Jersey specimens are proportionally a little longer than the original illustration of the species, and the mesial sinus of the pedicle valve is a little less angular, but these

MOLLUSCA.

GASTROPODA.

CYRTOLITES SINUATUS H. & W.

Plate IV., Fig. 9.

1877. *Cyrtolites sinuatus* H. & W., U. S. Geol. Expl., 40th par., vol. IV., p. 237, pl. 1, figs. 23–24.

Description.—Shell laterally compressed, composed of about two (?) slightly-embracing volutions. Cross-section of the outer volution subtriangular, the dorso-ventral diameter much greater than the lateral. Sides of the outer volution marked by a broad depression, which produces a conspicuous carination upon the dorsum of the shell for one-half the entire width of the outer volution. At the inner border of this depression the sides of the shell are somewhat abruptly elevated, then are rather narrowly rounded, dropping almost vertically into the umbilicus. The umbilicus large, exposing the inner volutions.

The maximum diameter of the only specimen observed is 8 mm.

Remarks.—The single specimen of this shell which has been observed in the New Jersey collections has only one side exposed. It agrees with the description and illustrations of the typical *C. sinuatus* described from the Pogonip limestone of Nevada, except that the lateral compression of the outer volution is even greater than in the Nevada shell, so that the portion of the shell immediately surrounding the umbilicus stands up conspicuously as a rounded ridge.

BELLEROPHON? sp. undet.

A single, imperfect specimen of a minute species of a Bellerophon-like shell has been observed in this fauna near Columbia. The diameter of the specimen is less than 5 mm.

RAPHISTOMA COLUMBIANA n. sp.

Plate IV., Figs. 3–5.

Description.—Shell about twice as wide as high, spire slightly elevated, with about three and one-half volutions, which are flat above and rounded below. The periphery sharply rounded, a little raised above the flattened portion of the volution within. On the rounded portion of the outer volution, just below the periphery and parallel with it, is a rather broad, shallow, ill-defined sulcus. Umbilicus small. Surface nearly smooth, the lines of growth being almost obsolete.

The dimensions of the type specimen are: maximum diameter, 13 mm.; height, 6.5 mm.

Remarks.—In general form this species resembles *R. staminea* Hall, from the Chazy limestone, but the upper portion of the volution is flatter, the conspicuous lines of growth described in that species are absent and the shell is smaller. In the internal casts the elevation of the periphery is not exhibited, the elevation, as well as the obscure sinus below, being the result of a thickening of the shell along that line. Such an elevation of the outer border of the shell is one of the characteristic features of the genus *Helicotoma,* and it is possible that the species under discussion should be placed in that genus.

LIOSPIRA sp. undet.

OPHILETA? sp. undet.

Among the specimens collected at Columbia are numerous fragmentary examples of a small, depressed, dish-like, coiled shell, with a broad, open umbilicus, which may be a member of the genus *Ophileta*. The specimens do not exceed 10 mm. in diameter.

ECCYLIOMPHALUS SUBELLIPTICA n. sp.

Plate IV., Fig. 6.

Description.—Shell loosely coiled, consisting of a little more than one volution, which increases gradually in diameter. Cross-section of the tube subelliptical in outline, slightly flattened above, subangular at the inner, upper margin, and rather sharply rounded on the periphery. Shell substance rather thick, nearly smooth or marked by indistinct lines of growth.

The dimensions of an average specimen are: maximum diameter, 27 mm.; width of outer volution at aperture, 7 mm.; height of same, 5 mm.; distance between the outer and inner volutions at the aperture, 2.75 mm.

Remarks.—In none of the specimens observed is there more than about one and a quarter volutions preserved, but the inner extremity of the shell is always somewhat blunt, so that some of the older portion of the shell may have been removed. The shell resembles *E. priscus* Whitf., from the Beekmantown limestone at Beekmantown, New York, but the size of the volutions increases more gradually, and none of the longitudinal flutings of that shell have been observed. It agrees even more closely with *E. multiseptarius* Cleland, from strata of similar age near Fort Hunter, New York, but lacks the strongly-concave, transverse septa of that species.

POLYGYRATA n. gen.

Shell depressed-conical, with many non-embracing volutions, whose cross-sections are rhomboidal. The umbilicus broad and open, its sloping sides subparallel with the sloping sides of the spire. The genus probably includes both sinistral and dextral species. Type of the genus *P. sinistra.*

POLYGYRATA SINISTRA n. sp.

Plate IV., Figs. 1–2.

Description.—Shell large, sinistral, depressed, conical. Volutions many, slightly elevated at the suture, not at all embracing. Umbilicus broad and open, its sloping sides subparallel with the sloping sides of the low spire. Cross-section of the volution rhomboidal, the width being twice the depth.

Maximum diameter of the type specimen, 37 mm.

Remarks.—The most perfect specimen of this species in the collection has been used for the construction of the diagrammatic illustrations here presented. In the vertical view the sutures actually preserved are represented by the full lines, the broken lines indicating the portion which has been supplied. On one side the specimen is broken in such a manner as to exhibit a cross-section of several volutions, and from this the cross-section of the shell here presented has been constructed.

This species resembles *Euomphalus polygyratus* Roem.,* from the lower Ordovician (?) of Texas, but differs from it in being a sinistral direction. All these species agree in having the broad, open umbilicus, and it is possible that all should be included in a single genus, which would, in that case, include both sinistral and dextral shells.

PLATYCERAS? COLUMBIANA n. sp.

Plate IV., Figs. 7–8.

Description.—Shell laterally compressed, composed of about two volutions; apex small, closely incurved, slightly depressed below the general plane of the shell. Outer volution expanding rapidly, sharply carinate along the dorsum; one side gently convex and but slightly elevated above the apex of the shell; the opposite side much more convex and rounding into a rather broad, open umbilicus. Surface of shell not well preserved, but apparently smooth, save for some inconspicuous lines of growth.

The dimensions of the type specimen are: maximum diameter, 13.5 mm.; length of aperture, 12 mm.; width of same, about 5 mm.

Remarks.—Only two specimens of this species, exhibiting opposite sides of the shell, have been observed, both of which have one side buried in the matrix. There is some question as to the genus in which this species should be placed. In a general way it resembles some species of *Raphistoma* or of *Maclurea,* but it differs from any of these in its small number of volutions, the outer one of which expands rapidly. It does not altogether agree with members of the genus *Platyceras,* but it may be provisionally considered as a much-compressed species of this genus.

CEPHALOPODA.

CYRTOCERAS sp. undet.

Plate III., Figs. 7–8.

Only two specimens of cephalopods have been observed in the fauna. One is a weathered, longitudinal section, exhibiting the chamber of habitation and a little more than 10 mm. of the septate portion of the shell. The other is an imperfect fragment of a shell about 8 mm. in length, whose transverse outline, so far as preserved, is semi-elliptical. The complete cross-section seems to have been ovate in outline, with the siphuncle near the broader side, though this cannot be certainly determined from the specimen. In this specimen several sutures are preserved, which are .5 mm. apart. In the specimen exhibiting the longitudinal section the sutures are slightly more distant and the shell is slightly curved. It is not certain that both these specimens belong to the same species, but neither of them is well enough preserved for identification.

ARTHROPODA.

TRILOBITA.

ISOTELUS CANALIS Whitf.

Plate III., Figs. 5–6.

1886. *Asaphus canalis* Whitf., Bull. Am. Mus. Nat. Hist., vol. I., p. 336, pl. 34, figs. 1–8.
1889. *Asaphus canalis* Whitf., Bull. Am. Mus. Nat. Hist., vol. II., p. 64, pls. 11–12.

This species is represented only by fragments of the free cheeks, genal spines and pygidia. The largest fragmentary free cheek ob-

Champlain. The specimens from the Trenton limestone of Minnesota, referred provisionally to this species by Clarke,* do not possess the nearly semi-circular head and pygidium of the Fort Cassin and New Jersey specimens, and are probably specifically distinct.

ILLAENURUS COLUMBIANA n. sp.

Plate V., Figs. 1–4.

Description.—Head semi-elliptical in outline; glabella subquadrate, strongly convex, occupying the entire width of the cranidium in front of the eye-lobes. The dorsal and occipital furrows nearly obsolete. Fixed cheeks small, subtriangular, restricted to the region back of the eye-lobes. Eye-lobes prominent, centrally located. Facial suture cutting the anterior margin of the head nearly in line with the base of the eye-lobes, passing in a nearly straight line to the anterior margin of the eye-lobe, and, after encircling this lobe, curving gently outward to the posterior margin. Free cheeks about one-third longer than wide, genal angles broadly rounded. On exfoliated specimens an indistinct, flattened rib extends the entire length of the head along its median line. Pygidium semi-elliptical in outline, axis ill-defined, with three or four nearly obsolete segments. Pluræ smooth, convex, segments obsolete. Surface of test smooth, except near the outer border of the free cheeks, where it is finely pitted, and near the genal angles, where it is marked with fine, raised lines parallel with the border.

The dimensions of a large cranidium are: length, 23 mm.; width at eye-lobes, 22 mm. A large pygidium is 13.5 mm. long and 17 mm. wide.

Remarks.—This is one of the commonest species in the Beekmantown fauna near Columbia, and the cranidia occur in all sizes, from 3 or 4 mm. in length to that of the large specimen illustrated, having a length of 23 mm. The pygidia are not so abundant as the cranidia.

Four species of the genus *Illænurus* have previously been described: *I. quadratus* Hall, from the Potsdam sandstone of Wisconsin; *I. convexus* Whitf., from the Lower Magnesian limestone of the same State; *I. dia* Walcott, from the Upper Cambrian of Texas, and *I.*

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* Pal. Minn., pt. II., p. 707.

eurekensis Walcott, from the Pogonip limestone of Nevada. The New Jersey species attains a larger size than any of the others, judging from their published illustrations. It differs from *I. quadratus* Hall in its less quadrangular cranidium, its proportionally narrower free cheeks and in its much more elongate pygidium. From *I. convexus* Whitf. it differs in having more prominent eye-lobes, in having a broader cranidium anteriorly and in having a much more elongate pygidium. From *I. dia* Walc. it differs in having a more elongate head, with narrower fixed cheeks in front. From *I. eurekensis* Walc. it may be distinguished by its more pointed and narrower cranidium anteriorly and by its somewhat narrower free cheeks.

The pygidium described as *Asaphus convexus* Cleland, from the Beekmantown limestone near Fort Hunter, New York, is evidently the pygidium of *I. columbiana,* and if Whitfield had not already described a member of the genus under the same specific name, Cleland's name would have been adopted. Associated with the pygidium called *Asaphus convexus* is an imperfect cranidium, which has been briefly described and illustrated by Cleland under the name *Bathyurus* sp.? This cranidium, also, in all probability is an incomplete specimen of our *Illænurus columbiana.*

BATHYURUS? sp. undet.

DESCRIPTION OF SPECIES IN THE TRENTON FAUNA.

COELENTERATA.

SPONGIAE.

HINDIA PARVA Ulrich.

Plate VI., Fig. 1.

1889. *Hindia parva* Ulrich, Am. Geol., vol. III., p. 244.
1895. *Hindia parva* W. & S., Pal. Minn., pt. I., p. 79, pl. G, figs. 7–9.

Description.—"Sponges free, globular in form, with an even, rounded surface. Specimens vary between 5 and 10 mm. in diameter, but in a large proportion of the specimens seen the diameter varies but little from 7 or 8 mm."—*Ulrich.*

Remarks.—Specimens of a small, globular sponge have been recognized from various localities in the collections of Trenton limestone fossils. They agree perfectly in external characters with the original description of *Hindia parva,* and are also indistinguishable from authentic specimens of that species from Wisconsin. Their condition of preservation is not such as to show the internal structure in thin sections.

RECEPTACULITES OCCIDENTALIS Salter.

Plate VI., Figs. 2–4.

1859. *Receptaculites occidentalis* Salter, Can. Org. Rem., Dec. 1, p. 45, pl. 10, figs. 1–7.
1884. *Receptaculites occidentalis* Hinde, Quart. Jour. Geol. Soc., Lond., vol. XL., p. 842, pl. 37, figs. 3–3 *m.*

Description.—Sponge forming discoïd or flattened, saucer-like expansions, attaining a diameter of 200 mm., and having a thickness varying from 4 mm. at the centre of the disk to 12 mm. at the margin.

The disk itself composed of vertical rods or spicules, with their extremities expanded and more or less flattened to form the two surfaces of the disk. The shafts of the spicules are cylindrical, about 1 mm. or slightly more in thickness, and separated from each other by interspaces about equal to their own thickness. The arrangement of the terminations of the spicules upon the surface of the disk is in curved, radiating lines, crossing after the manner of the engine-turned ornamentation of a watch. The expanded outer extremities of the spicules are rhomboidal in outline, leaving narrow, linear interstices on each side between adjoining spicules. A short distance above the flattened, rhomboidal extremity there are four connecting processes, which join the spicule with each of the adjoining ones. The inner extremities of the spicules are also expanded and joined together to form the inner surface of the disk.

Remarks.—Specimens of this species of *Receptaculites* are not uncommon in the lower beds of the Trenton limestone in New Jersey. The manner of preservation is always such as to exhibit poorly the structure of the fossil, as they can usually be detected only upon weathered surfaces of the rock, and are usually but fragmentary specimens. The largest specimen observed has a maximum diameter of 100 mm., but it is only a fragment, and, when complete, must have been at least 200 mm. in diameter.

ANTHOZOA.

steep sides and a convex floor; its depth, measured from the centre of its floor, is equal to rather less than one-third of the height of the corallum. Septa well developed, of two orders—primaries and secondaries—alternating, numbering in all mature individuals from ninety to one hundred and twenty, the primaries reaching the centre, with their inner ends twisted, the secondaries extending but a short distance inward from the wall. The free edges of the septa in the calyx are denticulated. Dissepiments at times having the appearance, in longitudinal sections of the corallum, of true tabulæ, irregular, subordinate to the septa between which they curve upwards convexly toward the centre of the visceral chamber, where they lose their individuality, and form, with the twisted inner ends of the primary septa, an axial area of cellulose structure."—*Lambe.*

Remarks.—This species occurs more or less abundantly in some strata of the Trenton limestone, but usually the specimens are in a poor condition of preservation. It is the only species of horn coral which has been recognized at this horizon.

NYCTOPORA BILLINGSI Nich.

Plate VII., Figs. 1–2.

1879. *Nyctopora billingsi* Nicholson, Pal. Tab. Corals, p. 184, pl. 9, figs. 3–3 *c*.

1899. *Nyctopora billingsi* Lambe, Cont. Can. Pal., vol. IV., pt. I., p. 49, pl. 2, figs. 1–1 *a*.

Description.—Corallum depressed hemispherical, spheroidal or pyriform, attaining a diameter of 40 to 50 mm. Corallites polygonal, 1 to 1.25 mm. in diameter, their walls of moderate thickness, in close contact and entirely coalesced. The septa rather thick, projecting but slightly into the cavity of the corallite, eight to twelve in number. Tabulæ horizontal, complete, two or three in the space of 1 mm. Mural pores minute, circular, arranged in no definite order.

Remarks.—The genus *Nyctopora* differs only from *Columnaria* in the presence of mural pores, and only one species of the genus has been described. This species most closely resembles *Columnaria halli* Nich. in the character of its septa, but the individual corallites are much smaller, rarely attaining a diameter of more than 1.25 mm., while in *C. halli* they are usually about 3 mm. in the adult condition. The corallum of *C. halli* also grows to a much larger size than does *Nyctopora*. The presence of mural pores can only be detected in thin sections of the coral.

ROMINGERIA? TRENTONENSIS n. sp.

Plate VI., Fig. 5.

Corallum consisting of loosely-spreading and sometimes anastomosing, irregularly subcylindrical, straight or curved branches, 5 to 10 mm. in diameter, each branch being formed by the aggregation of from six to ten of the subcylindrical corallites, which are in lateral contact throughout the greater portion of their length. The individual corallites subcylindrical in form, usually nearly straight, the sides diverging gradually from the initial point, attaining a length of from 5 to 10 mm. and a breadth of from 2 to 2.5 mm. The axes of the corallites diverge slightly from the axis of the branch of which they form a part, their sides in lateral contact, except distally, where at least the outer side and sometimes the whole corallite is free, and is frequently curved outward. The septa represented by vertical striæ, of which about twenty-five can be recognized at the aperture of the larger corallites. Tabulæ present, but not abundantly.

Remarks.—In some cases the surface of rather large slabs of limestone are entirely covered with fragments of the branching colonies

The specimens of this species which have been available for study are all imperfectly preserved, being present upon weathered surfaces of Trenton limestone slabs.

HYDROZOA.

ACTINOSTROMA TRENTONENSIS n. sp.

Plate VI., Fig. 8, and Plate VII., Figs. 3–4.

Description.—Cœnosteum subglobose or pyriform, often exceedingly irregular in form. In cross-section, as exposed on weathered surfaces, it is seen to consist of a series of concentric layers or laminæ, varying from 1 to 3 mm. in thickness, which, by the aid of a lens, are seen to be composed of minute, crowded, parallel fibres, whose direction is vertical to the surfaces of the laminæ. In the thin, vertical section, under the microscope, the fibrous structure is conspicuously exhibited, the vertical fibres being irregularly joined together by vertical, lateral, plate-like expansions. In the thin, transverse sections the vertical fibres, with their lateral expansions, are seen to coalesce in a most irregular manner, leaving numerous, vertical openings, which are exceedingly variable in form and size.

The usual diameter of masses of this organism is from 25 to 40 mm.

Remarks.—In the lower portion of the Trenton limestone, in strata which are probably of Black River age, certain beds are frequently more or less completely composed of the colonies of this organism, though upon the unweathered rock surfaces they often can scarcely be detected. On the weathered surfaces, however, they may usually be easily recognized by their texture and slightly different color, which distinguishes them from the matrix in which they are buried. The organism is clearly one of the Stromatoporoids, and has been placed provisionally in the genus *Actinostroma,* because of its conspicous fibrous structure. It differs from the usual members of that genus, however, in the apparent absence, or at least small number, of horizontal rods connecting the vertical fibres, which usually gives to the thin, vertical section of *Actinostroma* a reticulate appearance.

MOLLUSCOIDEA.

BRYOZOA.

PRASOPORA SIMULATRIX Ulrich.

Plate VIII., Figs. 1–3.

1886. *Prasopora simulatrix* Ulr., 14th Ann. Rep. Geol. Nat. Hist. Surv. Minn., p. 85.
1895. *Prasopora simulatrix* Ulr., Pal. Minn., pt. I., p. 245, pl. 16, figs. 1–10.

"Zoarium discoid in the younger stages, becoming hemispheric or subconical with age; occasionally the centre part of the upper surface is drawn out, and in a few instances has been observed even to divide into two branch-like lobes. The last conditions, as well as various other irregular developments, are to be considered as abnormal. Base more or less concave, usually with a central cicatrix of attachment, beyond which it is covered with a concentrically-striated and wrinkled epitheca. Upper surface celluliferous. Height of zoarium varying from 5 mm. or less to 50 mm. or more; diameter

3 mm. Those forming the clusters vary in size, generally, from 0.25 to 0.38 mm. Acanthopores wanting.

"*Internal Characters.*—These, as shown in over one hundred thin sections, are very constant in all the essential parts. In tangential sections the form of the zoœcial tubes varies from perfectly circular to polygonal, their walls in most cases being very thin, and the cavity of each intersected by the crescentic edges of one or more cystiphragms. The opening left by the cystiphragms is generally lateral and of bi-convex shape; occasionally it is subcentrally situated and oval, but more commonly two or more cystiphragms combine to give it a subtriangular form. An abnormality is sometimes met with in the confluence of two zoœcia. The zoœcia are in contact with each other only in part, perhaps only at limited points, the interspaces left between them being occupied by small mesopores. These vary somewhat in number, and more so in size, but are always decidedly angular. At intervals they are collected into substellate maculæ of greater or less extent, and in the immediate vicinity of these the zoœcia are of appreciably larger size than elsewhere. No evidence whatever of acanthopores has been detected.

"In vertical sections the cystiphragms form continuous series on one or both sides of the tubes, according as they extend all around the circumference or embrace only a portion of the same, while an equal number of straight diaphragms crosses the remaining portion of the tube."—*Ulrich.* The tabulation of the tubes is quite uniform, the cystiphragms averaging sixteen or seventeen in 2 mm. In the mesopores the diaphragms are simple, and average about eighteen in 1 mm.

Remarks.—This species of bryozoan is the most common one in the Trenton limestone of New Jersey. As it usually occurs, it is firmly imbedded in the limestone, so that only the cross-sections of the specimens can be observed. Only rarely is a complete colony weathered free from the matrix. Thin sections of the New Jersey specimens show them to be identical with the typical form of the species as described from Kentucky, Tennessee and Minnesota. The variety *orientalis,* said to come from New York and Canada, has not been detected among the New Jersey specimens.

agree more closely with *R. trentonensis* (Ulr.) than with any oth described species, but the specific identification cannot be made wit any certainty. In such specimens as exhibit the branching of th zoarium, the divisions are dichotomous and rather widely spreadin About eight rows of zoœcia are present on each side of the zoariu the specimens showing but little variation from this number. I most cases the external surface of the specimens adheres closely t the matrix, and the bifoliate zoarium divides along the mesothec The material may represent one or more undescribed species.

BRACHIOPODA.

LINGULA RICINIFORMIS Hall.

Plate IX., Fig. 8.

1847. *Lingula riciniformis* Hall, Pal. N. Y., vol. I., p. 95, pl. 30, figs. 2 *a–c*.
1893. *Lingula riciniformis* Winchell and Schuchert, Pal. Minn., pt. I., p. 343, pl. 29, fig. 9.

Description.—Shell subelliptical in outline, the anterior margin regularly rounded, the lateral margins slightly convex, subparallel, the postero-lateral margins rounded, the apex rather blunt. The two valves equally convex. Surface marked by concentric lines of growth.

LINGULA PHILOMELA Bill.?

Plate IX., Fig. 7.

1862. *Lingula philomela* Billings, Pal. Foss., vol. I., p. 49, fig. 53.
1893. *Lingula philomela* Winchell and Schuchert, Pal. Minn., pt. I., p. 342, pl. 29, figs. 7–8.

A few imperfect specimens of a much larger species of *Lingula* than the last have been noticed in the New Jersey collections. This species attains a length of nearly 25 mm., with a breadth of 11 mm. It has much the form of *L. philomela,* and is therefore provisionally identified with that species.

LINGULASMA GALENENSIS W. & S.

Plate IX., Figs. 10–11.

1892. *Lingulasma galenensis* Winchell and Schuchert, Am. Geol., vol. IX., p. 285.
1893. *Lingulasma galenensis.* Winchell and Schuchert, Pal. Minn., pt. I., p. 354, pl. 30, figs. 1–4.

Description.—Shell large, subquadrangular in outline, both valves convex. Anterior margin slightly convex, rounding narrowly at the sides into the straight, subparallel, lateral margins, the posterior margin convex, the postero-lateral angles rounded. Brachial valve more convex than the pedicle, the posterior third of its interior greatly elevated, as a concave platform, which is excavated in front and supported medially by a septum, which terminates at about the centre of the valve.

The dimensions of the only specimen observed are: length, 29 mm.; breadth, 24 mm.; convexity of brachial valve, 10 mm.

Remarks.—A single, imperfectly-preserved internal cast of this species has been observed. The internal characters of the brachial valve are fairly well exhibited, showing the form of the platform and the mesial septum. The pedicle valve is so badly crushed that its characters cannot be distinguished, but it is known that the valve also bears an internal, elevated platform somewhat similar to that of the brachial valve. The surface characters of the species cannot be recognized upon the New Jersey specimen.

SCHIZOCRANIA FILOSA (Hall).

Plate IX., Figs. 3–4.

1875. *Schizocrania filosa* Hall and Whitfield, Pal. Ohio, vol. II., p. 73, pl. 1, figs. 12–15.

Description.—Shell orbicular or subovate, the beak of the free or brachial valve projecting slightly beyond the limits of the circle, giving a somewhat greater diameter along the median line than in a transverse direction. Pedicle or attached valve discoid, very thin, deeply and broadly notched on the posterior side; the notch occupying nearly one-quarter of the circumference of the valve on the outer margin and extending nearly to the centre of the valve, its border thickened, especially at the base, which is rounded, with the centre marked by a slightly-projecting point, marked by strong, irregular, concentric undulations parallel to the margin, but interrupted by the border of the notch. Brachial or free valve moderately convex, most prominent near the centre, its surface marked by fine, even, thread-like, radiating striæ, which increase both by bifurcation and intercalation, and become stronger toward the border of the shell.

ORBICULOIDEA LAMELLOSA (Hall).

Plate IX., Figs. 1-2.

1892. *Orbiculoidea lamellosa* Hall and Clarke, Pal. N. Y., vol. VIII., pt. I., pl. 4 *E*, fig. 12.

Description.—Shell depressed-conical, nearly circular in outline, the apex of the brachial valve situated about one-third of the breadth of the shell from the margin. Surface marked by rather irregular, elevated, more or less lamellose, concentric lines, the grooves between the lines being rather wider than the ridges themselves.

Pedicle valve not observed in the New Jersey collections.

The dimensions of a nearly perfect brachial valve are: length, 9.5 mm.; width, 8.75 mm.; convexity, 2.5 mm.

Remarks.—With the possible exception of a single one, all the specimens of *Orbiculoidea* which have been observed in the Trenton limestone fauna of New Jersey belong to this species. It is characterized by rather conspicuous, sublamellose, concentric markings. and seems to agree with the descriptions and illustrations of *O. lamellosa.*

ORBICULOIDEA sp. undet.

Plate IX., Figs. 5-6.

A single specimen of a peculiar shell, which is apparently one of the inarticulate brachiopods, has been observed in a collection of Trenton limestone fossils from near Branchville, New Jersey. The form of the shell is obliquely subconical, the elevation of the bluntly-rounded apex being about three-fourths the width of the shell. The length is somewhat greater than the width, the outline of the margin being nearly elliptical.

The dimensions of the specimen are: length, 13 mm.; width, 10 mm.; convexity, 7.5 mm.

In general form the shell resembles some of the simple, cap-shaped gastropod shells, but the shell substance is that of the inarticulate brachiopods, such as *Orbiculoidea,* in which genus the shell has been placed provisionally. The pedicle valve has not been observed.

CRANIA sp. undet.

Plate IX., Fig. 9.

A few imperfect specimens of a species of *Crania* have been observed in the Trenton limestone of New Jersey. They resemble *C. trentonensis* Hall, but the apex of the brachial valve is usually close to the posterior margin.

RAFINESQUINA ALTERNATA (Emm.).

Plate IX., Figs. 12–13.

1873. *Strophomena alternata* Meek, Pal. Ohio, vol. I., p. 88, pl. 7, figs. 1–3.

Description.—Shell semi-elliptical or semi-circular in outline; greatest breadth of the shell along the hinge-line; cardinal extremities rectangular or sometimes more acutely angular, sometimes compressed and moderately deflected; lateral margins a little convex or slightly sinuous posteriorly, rounding forward to the front, which is semicircular in outline. Pedicle valve depressed, convex at the umbo, but usually much compressed over the whole visceral region in the valve. Surface of both valves marked by numerous, moderately-fine, radiating costæ. Those of the pedicle valve usually increasing by intercalation, and usually arranged with one to six or eight smaller and shorter ones between each two larger and more prominent ones, the largest one of which often occupies the mesial line. On the brachial valve the radiating striæ more frequently increase by division, and are usually more uniform in size. In addition to the radiating lines, the shell is marked by numerous, minute, regular, closely-arranged, concentric striæ, which are visible only on well-preserved specimens by the aid of a magnifying glass. A few more or less distinct, subimbricating lines of growth are also seen near the free margins of adult shells.

The approximate dimensions of a nearly-complete pedicle valve are: length 26 mm.; width, 31 mm. The species at times attains a much larger size than this, but the New Jersey specimens are usually smaller.

Remarks.—This very characteristic Ordovician brachiopod occurs abundantly in some strata of the Trenton limestone of New Jersey. Usually, however, it is not an abundant form, and the specimens are imperfectly preserved. The shell is a variable one in most of its characters, but it may always be recognized by its convex pedicle valve, with conspicuously alternating, radiate markings.

PLECTAMBONITES SERICEUS (Sowerby).

Plate IX., Figs. 14–15.

1873. *Leptæna sericea* Meek, Pal. Ohio, vol. I., p. 70, pl. 5, figs. 3 *a–h*.

Description.—Shell subsemi-elliptical or subsemi-circular in outline, concavo-convex, hinge-line equaling or usually a little longer than the breadth of the valves in front; cardinal extremities varying from nearly rectangular to acutely angular, anterior and lateral margins, forming together a nearly-regular, semi-circular curve. Pedicle valve moderately convex, nearly evenly, but gently, arched along the median line from the beak to the front; beak very small, scarcely, if at all, distinct from the cardinal margin; cardinal area two to three times as high as that of the opposite valve, inclined backward or more or less nearly parallel to the plane of the valve; delthyrium arched over near the beak by a small deltidium, and nearly closed between this and the hinge margin by the prominent cardinal process and chilidium of the other valve. Brachial valve concave, its greatest concavity near the middle, following nearly the curve of the pedicle valve, so as to leave but a narrow, visceral cavity within; beak not distinct from the cardinal margin; cardinal area narrow or nearly linear, lying at a right angle to the plane of the valve. Surface of both valves marked by numerous, fine, closely-arranged, equal, radiating costæ, or with every fourth, fifth or sixth one larger and more prominent than those between.

The dimensions of a very large specimen are: length, 15 mm.; width, 23 mm.

Remarks.—This a variable species, especially in regard to its size. In the Trenton limestone of New Jersey two forms are conspicuous, which are usually not associated in the same bed. A large form, having a width of 20 mm. or more, occurs usually in the lower strata, while higher up a smaller form, from 12 to 15 mm. in width, is abundant, often constituting almost entirely some of the thinner strata. The large form in the lower beds is frequently marked by several folds or wrinkles, of greater or less strength, on each side of the beak, which extend from the cardinal margin obliquely toward the median line of the shell. This species is probably more abundantly represented in the Trenton fauna of New Jersey than any other.

mens, or strongly elevated in flatter ones. Delthyrium as wide or wider than long, filled with a conspicuous, convex deltidium, which is broadly excavated anteriorly and occupied by the chilidium. Brachial valve flattened or slightly concave in the umbonal region, more or less strongly convex laterally and anteriorly, often with a shallow, narrow sinus extending from the beak to the middle of the shell, and with a broadly-rounded median fold near the front margin; cardinal area narrow, vertical, centrally occupied by a broad and short chilidium. Surface of both valves marked by numerous, fine, subequal, crowded, rounded or subangular costæ, which increase by intercalation, every second, third or fourth one being more prominent. The whole surface is also crossed by numerous, crowded, delicate, raised, concentric lines and by a few stronger marks of growth. In some specimens oblique wrinkles are present along the cardinal margin on each side of the beaks.

The dimensions of a medium-sized brachial valve are: length, 17 mm.; width, 23 mm.; convexity, 8 mm.

Remarks.—This species occurs quite commonly in the Trenton fauna. In its more or less imperfect condition of preservation it may sometimes be confused with *Rafinesquina alternata,* although its brachial valve, and not its pedicle valve, is convex. On the convex valve of *S. incurvata,* however, there is always a slight flattening or shallow concavity near the beak, while in *R. alternata* the same portion of the shell is slightly convex. The delicate concentric surface markings of this species are characteristic, but these are usually destroyed upon the New Jersey specimens, because of their manner of preservation.

ORTHIS TRICENARIA Conrad.

Plate IX., Figs. 18–21.

1892. *Orthis tricenaria* Hall and Clarke, Pal. N. Y., vol. VIII., pt. I., pl. 5, figs. 9–14.

Description.—Shell plano-convex, longitudinally semi-elliptical in outline; hinge-line equal to the greatest width of the shell, rarely shorter. Cardinal area well developed on each valve. Surface marked by thirty to thirty-six usually nearly equal, simple, subangular, radiating costæ, which are crossed by exceedingly delicate, concentric lines of growth. Pedicle valve strongly convex, subangular along the median line, with the greatest elevation on the umbo. Cardinal area very high, more or less concave, striated longitudinally and transversely, divided by a very narrow delthyrium, whose apical third is occupied by a flat, concave or convex deltidium. Brachial valve nearly flat, slightly elevated at the beak, from which point the surface slopes gradually into a broad, scarcely-perceptible, rarely well-defined, median sinus. Cardinal area nearly one-third as wide as that of the pedicle valve, flat, divided by a triangular delthyrium, which is as broad as long and more or less covered by a convex chilidium, the anterior margin of which is concave.

The dimensions of a rather large specimen are: length, 19 mm.; width, 20 mm.; thickness, 10.5 mm.

Remarks.—The presence of this species always indicates a low Trenton horizon, it being entirely absent from the higher beds. The New Jersey specimens are always poorly preserved, being more or less exfoliated, the two valves being rarely found in articulation.

PLECTORTHIS PLICATELLA (Hall).

Plate IX., Figs. 22–24.

1847. *Orthis plicatella* Hall, Pal. N. Y., vol. I., p. 122, pl. 32, fig. 9.
1892. *Plectorthis plicatella* Hall and Clarke, Pal. N. Y., vol. VIII., pt. I., p. 194, pl. 5, figs. 18–20.
1895. *Orthis* (*Plectorthis*) *plicatella* Winchell and Schuchert, Pal.

The dimensions of a rather large individual are: length, 18 mm.; breadth, 21 mm.; convexity of both valves, 9 mm.

Remarks.—This species is not uncommon in many of the middle and upper beds of the Jacksonburg section, and also frequently occurs elsewhere. The New Jersey specimens differ from the Cincinnatian shells, which are referred to this species in being generally longer in proportion to the breadth, some of the New Jersey specimens being nearly subcircular in outline. When imperfectly preserved, it is frequently difficult to separate specimens of this species from *Dinorthis pectinella,* but in complete specimens the pedicle valve of *P. plicatella* is much more convex and the cardinal area slopes backward much more than in *D. pectinella.* The brachial valves of the two species, as preserved in the New Jersey rocks, are frequently wholly indistinguishable.

PLATYSTROPHIA BIFORATA (Schl.).

Plate IX., Figs. 25–28.

1895. *Platystrophia biforata* W. & S., Pal. Minn., pt. I., p. 455, pl. 33, figs. 51–54.

Description.—Shell subequally biconvex, with strong fold and sinus, wider than long, the breadth ranging from 10 to 20 mm. Hinge-line equal to or a little shorter than the greatest width of the shell. Cardinal angles rectangular or a little obtuse. Lateral margins straight or slightly convex at first, then curving gently into the regularly-rounded front. Surface of each valve marked by from thirteen to eighteen strong, angular plications, of which three or four occupy the fold and sinus. Pedicle valve most prominent on the umbo, more or less flattened towards the cardinal extremities; beak incurved and pointed; cardinal area well defined; sinus reaching nearly to the point of the beak, where it is occupied by a single plication, sharply defined by an angular plication on each side, deep and rounded anteriorly, where one or two additional plications are added on either side of the initial central one. Brachial valve with its greatest elevation in the centre, more or less flattened toward the cardinal angles; cardinal area nearly equal to that of the pedicle valve; the fold prominent and sharply defined.

The dimensions of a nearly-perfect specimen are: length, 9.5 mm.; width, 12 mm.; thickness, 7 mm.

Remarks.—As it occurs in the Trenton limestone of New Jersey, this species never grows to the large size which it frequently attains elsewhere. The largest specimens observed do not exceed 20 mm. in breadth and but few specimens exceed 15 mm. The range of variation among the New Jersey specimens is not great, and the above description has been drawn up to accord with these as nearly as possible.

DINORTHIS PECTINELLA (Emm.).

Plate IX., Figs. 29-30.

1892. *Orthis* (*Dinorthis*) *pectinella* Hall and Clarke, Pal. N. Y., vol. VIII., pt. I., pl. 5, figs. 27–33.

Description.—Shell resupinate, transversely subelliptical in outline, wider than long, in about the proportion of four to three; cardinal line usually less than the greatest width of the shell, the cardinal extremities rounded; surface of each valve marked by from twenty-two to thirty prominent, rounded, simple costæ, which are equal in width to the spaces between, and are crossed by fine, closely-crowded, elevated, concentric lines of growth. Pedicle valve slightly convex

DALMANELLA TESTUDINARIA (Dal.).

Plate X., Figs. 1-2.

1895. *Orthis* (*Dalmanella*) *testudinaria* W. & S., Pal. Minn., pt. I., p. 441, pl. 33, figs. 17-22.

Description.—Adult shells subcircular and the younger ones transversely subelliptical in outline; hinge-line less than the greatest width; cardinal angles rounded, lateral and anterior margins broadly rounded, though the extreme front of the shell is sometimes straight for a short distance. Surface of both valves marked by unequal, angular, radiating costæ, about ten or twelve of the largest ones having their origin at the beak, the remainder being lateral branches from these. In some of the larger individuals as many as sixty or more costæ are present along the margin of the shell. The branches from the main costæ are small at first, but increase in size towards the margin of the shell, and themselves give off additional branches. In many individuals this manner of branching gives to the costæ a more or less fasciculate appearance, each fascicle having one large rib in the centre, with smaller ones on either side. In those specimens having the shell well preserved the bottoms of the grooves between the costæ exhibit a series of fine, transverse crenulations. Pedicle valve convex, subcarinate along the median line, the lateral slopes nearly straight, the greatest convexity of the valve about one-third the distance from the beak. Cardinal area moderately concave, forming an angle of about 45° with the plane of the valve, about five or six times as wide as high. Delthyrium a little higher than wide. Brachial valve nearly flat, with a sinus beginning close to the beak and expanding in a broad, shallow depression towards the front.

The dimensions of an average-sized specimen are: length, 8 mm.; width, 8.25 mm.; convexity of pedicle valve, 2.5 mm.

Remarks.—This species is nearly as abundant in the Trenton limestone as *Plectambonites sericeus*. The New Jersey specimens are all of one variety, which are particularly characterized by the subcarinate pedicle valve and the rather coarse, fasciculately-arranged radiating costæ.

DALMANELLA SUBAEQUATA (Con.).

Plate X., Figs. 3-4.

1843. *Orthis subæquata* Conrad, Proc. Acad. Nat. Sci. Phil., vol. I., p. 333.
1847. *Orthis subæquata* Hall, Pal. N. Y., vol. I., p. 118, pl. 32, fig. 2.
1892. *Dalmanella subæquata* Hall and Clarke, Pal. N. Y., vol. VIII., pt. I., p. 207, pl. 5 *c*, figs. 6–11.
1895. *Orthis* (*Dalmanella*) *subæquata* Winchell and Schuchert, Pal. Minn., pt. I., p. 446, pl. 33, figs. 30–36.

Description.—Shell subequally biconvex, usually wider than long; the hinge-line shorter than the greatest width of the shell, except sometimes in young individuals; cardinal extremities angular or rounded. Surface of each valve marked by numerous, fine, tubulose striæ, which bifurcate about twice in passing from the beak to the anterior margin. Pedicle valve strongly and evenly convex, the greatest elevation posterior to the middle of the shell; near the beak and upon the umbo no mesial depression exists, but near the middle of the valve a broad, shallow and indistinct sinus begins and becomes deeper toward the anterior margin. The cardinal area is well defined, broadly triangular, elevated and only moderately concave; the delthyrium, with slightly-curved sides, is about twice as high as wide. Brachial valve more evenly, but a little less, convex than the pedicle, the greatest elevation near the middle. Near the beak the mesial

SCENIDIUM ANTHONENSIS Sard.

Plate X., Figs. 5–7.

1892. *Scenidium anthonensis* Sardeson, Bull Minn. Acad. Nat. Sci., vol. III., p. 333, pl. 4, fig. 7.
1893. *Scenidium anthonensis* Winchell and Schuchert, Pal. Minn., pt. I., p. 381, pl. 30, figs. 20–23.

Description.—Shell small, subsemi-circular in outline, the greatest width along the hinge-line. Each valve marked by from twenty to twenty-six simple, rounded plications. Pedicle valve subpyramidal, the beak erect; cardinal area large, flat, broadly triangular, with a large delthyrium. Along the median line a slight elevation or ill-defined fold is developed. In the interior of the apical portion of the valve is a small spondylium. Brachial valve depressed, convex, with a slight mesial sinus.

The dimensions of an average specimen are: length, 2.5 mm., and breadth, 5 mm.

Remarks.—This species has been only rarely observed, and is restricted to the lower portion of the Trenton formation, which is of Black River age or older.

CAMARELLA INORNATA n. sp.

Plate X., Figs. 8–10.

Description.—Shell subovate in outline, lenticular or subglobose, with subequally convex valves, varying from longer than broad to broader than long. Surface nearly smooth, marked only by fine, inconspicuous, concentric lines of growth. Pedicle valve with a pointed, incurved beak; the sinus originating near the middle of the valve and deepening towards the anterior margin. Brachial valve quite regularly convex, with little or no mesial elevation, even having a slight sinus towards the front in some individuals.

The dimensions of a rather large individual are: length, 15 mm.; breadth, 15 mm.; thickness, 9 mm. Another individual: length, 10 mm.; breadth, 10.4 mm.; thickness, 7.2 mm. Another pedicle valve: length, 14 mm.; breadth, 16 mm.

Remarks.—The internal characters of this shell have not been observed, so that its generic reference may be erroneous. Externally it resembles members of the genus *Camarella* more closely than any other shells which occur at this horizon. It differs from *C. ambigua* H. in the absence of the strong fold of the brachial valve and in the smaller sinus of the pedicle valve. From *C. panderi* Bill. it may be distinguished by its larger size and by the absence of the median plication in the sinus of the pedicle valve.

PARASTROPHIA HEMIPLICATA (Hall).

Plate X., Figs. 11–14.

Description.—Shell subglobose, subpentagonal in outline, wider than long, the thickness frequently equal to the length. Cardinal line short, with sometimes the appearance of a small area on the pedicle valve. Each valve marked by from eight to twelve simple, subangular, radiating plications, which reach from one-third to one-half the distance from the margin to the beak, leaving the older portion of each valve smooth. Besides the radiating plications, the entire surface is marked by fine, concentric, subimbricating lines of growth, which are more conspicuous near the margin of the shell. Pedicle valve depressed-convex, with an abrupt, broad, but not deep sinus, which originates about one-third of the distance from the beak to the anterior margin, and is produced as a lingual extension in front at nearly a right angle to the plane of the valve; it is marked by from three to five radiating plications. The beak is small, closely incurved; delthyrium small and triangular. Brachial valve strongly convex or gibbous, with a broad

RHYNCHOTREMA INAEQUIVALVIS (Castel.).

Plate X., Figs. 15–18.

1895. *Rhynchotrema inæquivalvis* W. & S., Pal. Minn., pt. I., p. 459, pl. 34, figs. 9–25.

Description.—Shell varying from narrowly to broadly subtriangular in outline. Each valve marked by from sixteen to twenty-two simple, prominent, subangular plications, with from three to five on the fold and two to four in the sinus. Pedicle valve strongly convex in the umbonal region, sloping more or less abruptly laterally, often angular near the anterior margin; mesial sinus originating on the umbo, often profound anteriorly, with abrupt sides. Beak more or less incurved, and always elevated beyond the umbo of the dorsal valve, with a narrow dethyrium, partially closed by deltidial plates. Brachial valve more convex than the other, mesial fold beginning at the apex of the shell as a flattening or slight depression, more or less strongly elevated anteriorly. Beak projecting into the delthyrium of the pedicle valve.

The dimensions of an average specimen are: length, 10 mm.; width, 11 mm.; thickness, 6.5 mm.

Remarks.—This species is a common one in some localities of the Trenton limestone of New Jersey in the lower half of the formation, but it is never preserved so as to show the more delicate surface characters. On well-preserved specimens from some other regions the shell is marked by conspicuous, sublamellose, concentric growth lines, which are crowded near the anterior margin of the shell, but these are not exhibited on any New Jersey specimens which have come under observation.

RHYNCHOTREMA DENTATA (Hall).

Plate X., Figs. 19–22.

1847. *Atrypa dentata* Hall, Pal. N. Y., vol. I., p. 148, pl. 33, figs. 14 *a–c*.

Description.—Shell small, transversely subelliptical in outline, the proportions of length to breadth being about as five to six; obtusely angular at the beak. Each valve marked by seven or eight simple, angular, radiating plications on each side of the fold and sinus, with one plication in the bottom of the sinus of the pedicle valve and two upon the fold of the brachial valve. The interlocking, angular plications give to the anterior and lateral margins of the shell, in an anterior view, a sharply zig-zag outline. Crossing the plications, and parallel with the margin, are fine, concentric lines of growth, which can only be detected by the aid of a magnifying glass. Pedicle valve strongly arched from beak to front, the plications bounding the sinus very prominent, the lateral slopes concave, so that the valve just at the beak and a little in front is subcarinate. Sinus not continuous to the beak. At the beak the median plication is slightly elevated above the two adjacent ones, but in passing anteriorly it soon becomes depressed below them, and at the anterior margin occupies the bottom of the rather profound sinus. Brachial valve less convex than the opposite one, flattened in the middle and passing in a convex curve to the margin all around, except directly in front in the area occupied by the median fold. The fold, starting at the beak as a narrow, shallow sinus, becomes elevated above the general surface of the shell at a point about one-third the distance from the beak to the anterior margin.

The dimensions of a perfect specimen are: length, 5 mm.; width, 6 mm.; thickness, 3 mm.

Remarks.—This species was originally described from the Trenton limestone of Lewis county, New York; but it seems to be a rare shell

ZYGOSPIRA RECURVIROSTRA (Hall).

Plate X., Figs. 23–26.

1895. *Zygospira recurvirostra* W. & S., Pal. Minn., pt. I., p. 466, pl. 34, figs. 38–41.

Description.—Shell small, subcircular or longitudinally subovate in outline, subglobular; surface of both valves marked by twenty-four to twenty-eight rounded or subangular, radiating plications, which are crossed by fine, concentric lines of growth. Pedicle valve gibbous, with its greatest elevation near the centre; subcarinate near the beak, the keel becoming broader toward the front and forming a rather well-defined, more or less flat-topped median fold; beak small and pointed, incurved over the beak of the brachial valve. Brachial valve less convex than the other, marked by a rather broad, shallow, rounded median sinus, which corresponds with the fold of the pedicle valve and which reaches nearly to the beak.

The dimensions of an average specimen are: length, 6 mm.; width, 6 mm.; thickness, 4 mm.

ZYGOSPIRA NICOLLETI (W. & S.).

Plate X., Figs. 27–30.

1892. *Hallina nicolleti* W. & S., Am. Geol., vol. IX., p. 293.
1893. *Hallina nicolleti* W. & S., Pal. Minn., pt. I., p. 474, pl. 34, figs. 59–62.
1893. *Zygospira nicolleti* B. & S., Proc. Biol. Soc. Wash., vol. VIII., pp. 74, 81, pl. 10, fig. 23, pl. 11, figs. 11–12.

Description.—Shell small, rostrate, elongate-oval to subcircular in outline, smooth. Pedicle valve subcarinate, with a slight mesial depression in the carina near the front margin; beak acute, not incurved, the lateral slopes, from the carina to the sides, concave. Brachial valve less convex than the pedicle, with a rounded, mesial sinus extending from near the beak to the front margin.

The dimensions of an average specimen are: length, 3.5 mm.; breadth, 2.8 mm.; thickness 1.8 mm.

Remarks.—This interesting species has hitherto been recorded only from the Mississippi valley. The New Jersey specimens are indistinguishable from the western ones, but are somewhat smaller, the largest specimen observed being less than 5 mm. in length. In the eastern specimens the faint marginal plications, which are present in the larger western individuals, have not been observed.

MOLLUSCA.

PELECYPODA.

CUNEAMYA TRUNCATULA Ulr.

Plate XI., Fig. 6.

1897. *Cuneamya truncatula* Ulr., Pal. Minn., pt. II., p. 622, pl. 36, fig. 39.

Description.—"Shell of medium size, transversely somewhat elongate, the two ends of nearly equal height, with broad, compressed, beak to the antero-basal angle; between it and the edge of the lunule a narrow sulcus; behind it a small, well-marked, mesial sulcus, out of which the surface rises more gradually to the summit of the posterior umbonal ridge. The most prominent point of the surface of the valves is situated on this ridge, somewhat above the middle of the height and about two-fifths of the length from the anterior extremity. Surface marked with nearly equal, concentric undulations or ridges. These are strongest in the mesial sulcus, somewhat flattened, yet distinct, in the anterior sulcus, and nearly obsolete on the cardinal slope. Hinge and muscular impressions undetermined."—*Ulrich.*

Remarks.—The most perfect individual of this species which has been observed from the Trenton limestone of New Jersey differs from the illustration of the type of the species in having the posterior cardinal portion of the shell less alate. In all other respects the agreement between the two shells is very close, and there seems to be no justification in considering them as specifically distinct.

CTENODONTA NASUTA (Hall).

Plate XI., Fig. 1.

1897. *Ctenodonta nasuta* Ulr., Pal. Minn., pt. II., p. 584, pl. 42, fig. 30.

Description.—"Shells transversely elongate, subovate, the length one-twentieth or more greater than twice the greatest height; beaks rather small, not very prominent, incurved, situated about one-twelfth of the entire length in front of the middle; anterior end large, broadly and regularly rounded; posterior end produced, tapering, rather narrowly rounded at the extremity; cardinal margin nearly straight, basal line broadly convex, except for some distance behind the middle, where it is straight or, more often, gently sinuate. Greatest thickness near the middle of the anterior half, equaling about one-third of the length of the shell. Umbones moderately inflated, the posterior cardinal slope defined by an obscure umbonal ridge, very abrupt for a short distance behind the beaks, more so than on the anterior side; a broad and very shallow sulcus crosses the valves obliquely from the umbones to the contraction in the base. Ligament attached to a sharply-defined groove on each side of the hinge-line, extending from the beaks about one-third of the distance to the posterior extremity. Surface marked by obscure, concentric lines."—*Ulrich.*

The dimensions of a large right valve are: length, 58 mm.; height, 26 mm.; convexity, 8 mm.

Remarks.—Two forms of shells in the Trenton limestone of New Jersey have been identified as *C. nasuta.* One of these is represented by the large specimen which has been illustrated, and occurs in the lower portion of the formation, associated with *Leperditia fabulites,* &c., in strata which are doubtless of Black River age. All of the specimens found at this horizon are more or less fragmentary, but all are of this large form of the species. Much higher up in the formation, associated with a typical Trenton fauna, a small form of the species is occasionally met with, which does not have a length to exceed 25 mm. So far as the specimens of both forms are preserved, they seem to be identical in all respects, except in size.

CTENODONTA JERSEYENSIS n. sp.

Plate XI., Fig. 17.

Description.—Shell of medium size, moderately convex, longitudinally subovate in outline. Beak small, situated a little in front of the middle, closely incurved and pointing posteriorly. Umbo flat-

CTENODONTA LEVATA (Hall).

Plate XI., Figs. 18–22.

1847. *Nucula levata* Hall, Pal. N. Y., vol. I., p. 150, pl. 34, figs. 1 *a–k*.

Ctenodonta levata, as described by Hall under the name *Nucula levata,* undoubtedly includes shells which belong to several distinct species. There are much greater differences exhibited among the several specimens illustrated by Hall which are referred to this species than among many of the species of the *levata* group of the genus *Ctenodonta* described by Ulrich. Apparently all of the small, pelecypod shells having this general form were referred by Hall to a single species, and the exact value of *C. levata* can only be determined when Hall's original specimens are more thoroughly investigated.

In the fauna of the Trenton limestone of New Jersey more or less imperfect specimens of what are clearly several small species of *Ctenodonta* are not infrequently met with, most of them agreeing more or less closely with one or another of Hall's illustrations of *C. levata.* They are usually not in a proper condition of preservation for accurate identification or description, and although some of them resemble more or less closely some of Ulrich's species of the genus, none of them can be specifically identified with any certainty. Under these circumstances, it is thought best to refer them all to *C. levata,* as Hall undoubtedly would have done at the time he established the species, at the same time keeping in mind that this name is a sort of catch-all for these small, pelecypod shells, awaiting a thorough revision of the genus.

CLIDOPHORUS NEGLECTUS Hall.

Plate XI., Fig. 16.

1897. *Clidophorus neglectus* Ulrich, Pal. Minn., pt. II., p. 607, pl. 42, figs. 20–25.

Description.—"Shell transversely subelliptic, rather strongly convex; ends subequally rounded, the anterior generally a little narrower than the posterior; the outline of the latter, however, often exhibits a tendency to become angular just beneath the middle and obliquely subtruncate above; basal and dorsal margins broadly convex. Beaks small, somewhat tumid, placed about one-third of the length of the shell behind the anterior extremity. Surface marked by fine, concentric lines and several stronger varices of growth; the latter show through the shell, so as to be visible on casts of the interior. Hinge-plate narrow, not over half the length of the shell, minutely toothed; denticles twenty or more in each valve, three-fourths of the number being posterior to the beaks, placed obliquely and so that they converge inwardly, the direction of the anterior series being nearly at right angles to that of the posterior series. Clavicle strong, nearly straight, almost vertical, sharply defining the somewhat semi-circular and large anterior, muscular scar, and leaving a strong furrow in casts of the interior just in advance of each beak. The furrow extends beyond the middle of the distance to the basal margin. Posterior scar faint, smaller than the anterior, occupying a central position on the post-cardinal slope. Several small umbonal scars may be observed on good casts, and obscure rays are occasionally visible on their sides."—*Ulrich.*

The dimensions of a left valve are: length, 9 mm.; height, 5 mm.

Remarks.—Only a few specimens of this species have been found in the Trenton limestone of New Jersey. They are all more or less imperfect casts of the interior of the shell, and are somewhat more [redacted] ually into the broadly and uniformly-curved posterior margin; basal line most prominent and strongly convex behind the centre, in front of which point it ascends rather rapidly, with a much more gentle curve, into the short, small and sharply-rounded anterior end. Umbones full, large and prominent, beaks small and strongly incurved; umbonal ridge subangular near the beaks only, inconspicuous in a lateral view. Surface marked with concentric lines of growth. These, with the exception of a few near the margin, are obscure in the material at hand. Ligamental area very narrow. Hinge-plate of moderate strength, with three slightly-curved and nearly-horizontal cardinal teeth and two or three slender, posterior, lateral teeth in each valve. Pallial line and anterior adductor muscle distinct, the latter rather small and of obovate or subcircular shape; posterior adductor faintly impressed, situated immediately beneath the lateral teeth. Internal umbonal sulcus and ridge slightly developed, but always distinguishable on good casts of the interior."—*Ulrich.*

The dimensions of a somewhat imperfect specimen are: length, 17 mm.; height, 18 mm.; thickness through both valves, 12 mm.

Remarks.—This species has not been found abundantly in the Trenton limestone of New Jersey, but the specimens seem to be identical with the more typical representatives of the species from the Mississippi valley, except in being somewhat smaller.

CYRTODONTA CANADENSIS Bill.

Plate XI., Fig. 3.

1858. *Cyrtodonta canadensis* Bill., Can. Nat. and Geol., vol. III., p. 434, figs. 8–10.

Description.—"Transversely broad-oval; anterior, posterior and ventral margins, and also the posterior half of the dorsal margin, regularly rounded; a portion of the ventral margin about the centre of the width is sometimes nearly straight; dorsal margin elevated, somewhat compressed; diagonally and rounded ventricose from the umbones towards the posterior ventral angle; beaks short, obtusely rounded, incurved; surface nearly smooth or obscurely marked with concentric ridges; a few strong, imbricating lamellæ of growth near the margin of some specimens."—*Billings.*

The approximate dimensions of an imperfect right valve from New Jersey are: length, 40 mm.; height, 35 mm.; convexity, 11 mm.

Remarks.—A large species of *Cyrtodonta* from the lower portion of the Trenton limestone in New Jersey seems to agree closely with Billings' description and illustrations of *C. canadensis,* the only difference noticeable being that the anterior margin is more broadly rounded. None of the species are perfectly preserved, and there may be some doubt as to the correctness of the identification, but more perfectly-preserved specimens are essential before a specific distinction can certainly be made.

WHITELLA SUBORBICULARIS n. sp.

Plate XI., Fig. 2.

Description.—Shell of medium size, erect, ventricose, suborbicular in outline, the hinge-line rather long, arcuate. Beaks of moderate size, prominent, strongly incurved; umbones prominent, umbonal ridge sharply angular near the beak, becoming more broadly rounded after passing the umbonal region. The post-umbonal slope abrupt, concave, with the suggestion of a faint second ridge, diverging from near the beak, about one-third of the distance from the umbonal ridge to the posterior margin. The anterior slope, from the umbonal ridge, is

WHITELLA SUBTRUNCATA (Hall).

Plate XI., Fig. 4.

1847. *Edmondia subtruncata* Hall, Pal. N. Y., vol. I., p. 156, pl. 35, figs. 3 *a–b* (not fig. 3 *c*, or pl. 34, fig. 9).

Description.—Shell oblique, elongate, ventricose, subelliptical in outline. Beaks small, prominent, strongly incurved; umbones prominent, projecting beyond the hinge-line. Anterior extremity of the shell rather sharply rounded, the antero-basal margin gently convex or nearly straight, the posterior extremity broadly rounded, the postero-dorsal margin convex, rounding into the posterior extremity of the arcuate hinge-line. Umbonal ridge arcuate, sharply angular near the beak, becoming more and more broadly rounded as it approaches the postero-basal extremity of the shell. The post-umbonal slope abrupt, concave; the anterior slope convex.

The dimensions of a nearly-perfect right valve are: length from beak to postero-basal extremity, 37 mm.; width at right angles to last dimension, 25 mm.; convexity, 11 mm.

Remarks.—The several specimens illustrated by Hall to represent *Edmondia subtruncata* undoubtedly belong to more than one species and probably to two or more genera. The New Jersey shell which is referred to this species is somewhat common in some of the higher Trenton beds in the Jacksonburg section, and is believed to be specifically identical with Hall's specimen illustrated by figure 3 *a*. Figure 3 *b* may also be the same, but the other specimens illustrated are distinct. The New Jersey specimens are evidently members of the genus *Whitella*, and the species is here transferred to that genus.

MODIOLOPSIS FABA (Con.).

Plate XI., Figs. 13–15.

1847. *Modiolopsis faba* Hall, Pal. N. Y., vol. I., p. 158, pl. 35, figs. 6 *a–c*.

Description.—Shell small, about twice as long as high, the greatest height in the posterior half; the beak situated about one-fifth the length of the shell from the anterior extremity, somewhat compressed and slightly incurved; the postero-cardinal region subalate. Basal and cardinal margins diverging posteriorly; the anterior end rather sharply rounded; the basal margin more or less sinuate at or a little in front of the middle of the shell, curving upward, both in front and behind, to meet the anterior and posterior margins; posterior margin broadly rounded below and obliquely truncate above. Umbonal ridge extending from the beak obliquely backward to the postero-basal portion of the shell, sharply rounded or subangular near the beak, but becoming more broadly rounded posteriorly. In front of the umbonal ridge, extending from the beak obliquely backward to near the middle of the basal margin, is a rather broad and shallow sinus, which gives rise to the sinuosity of the basal margin. The most prominent point on the surface of the shell is upon the umbonal ridge at about the centre of the shell. Surface marked with somewhat irregular, concentric lines of growth, which are usually more or less inconspicuous.

The dimensions of average specimens are: length, 6 to 7 mm.; height, 3.5 to 4 mm.

Remarks.—This is one of the commoner species of pelecypods in the fauna of the higher beds of the Trenton formation, and it is believed to be identical with the little shell described from the New York Trenton limestone as *Modiolopsis faba.* The greater number of specimens preserved are right valves. Only a few left valves have been seen; they are slightly less convex, with a less conspicuous umbonal ridge.

beak obliquely backward to the basal margin. Anterior extremity of the shell compressed. The most prominent point on the shell is near the centre, on the umbonal ridge. Surface marked by more or less obscure, concentric lines of growth.

The dimensions of a perfect cast of the right valve are: length, 15 mm.; width, 10 mm.; convexity, 3 mm.

Remarks.—This species may be recognized by its rather short and broad form, the flattened umbo and the oblique sinus.

MODIOLOPSIS DEPRESSA n. sp.

Plate XI., Fig. 8.

Description.—Shell subovate in outline, the valves depressed-convex. Anterior margin regularly rounded from beneath the beak into the nearly-straight or slightly-convex basal margin; the posterior margin broadly and regularly rounded. Beak small, a little elevated above the hinge-line; umbonal ridge broadly rounded and ill-defined; the post-umbonal slope convex above, becoming concave toward the hinge-line; antero-basal slope with a rather broad, shallow, ill-defined depression or sinus extending from the basal margin half way to the beak. Surface marked by obscure, concentric lines of growth.

The dimensions of a nearly-complete right valve are: length, 16 mm.; width, 10.5 mm.; convexity, 1.5 mm.

Remarks.—This species may be recognized by its depressed-convex, nearly-smooth valves, with obscure umbonal ridge and small beak.

ORTHODESMA CANALICULATUM Ulrich.

Plate XI., Fig. 5.

1897. *Orthodesma canaliculatum* Ulr., Pal. Minn., pt. II., p. 520, pl. 37, figs. 7–11.

Description.—"Shell elongate, the length three times the height; cardinal and basal margins straight, nearly parallel; posterior margin oblique, rounding into the hinge-line, below which it slopes backward with a gentle curve to the postero-basal extremity, where it turns abruptly into the basal line; anterior end contracted in front of the beaks, of moderate length, rounded, most prominent a little above the middle. In a side view the beaks project very little, are compressed by a broad, shallow sulcus, which crosses the valves and occupies a large part of the anterior three-fifths of the shell; umbonal ridge rather distinct, extending from the beaks to the postero-basal extremity. In a cardinal view of casts of the interior, the only condition in which the species has been noticed, the hinge-line is strongly depressed, lying at the bottom of a wide and deep channel, deepest between the rather widely-separated beaks and gradually shallowing posteriorly. Casts usually almost smooth, exhibiting only a small number of obscure, concentric furrows. One specimen preserves a small part of the shell, and this shows that near the dorsal edge the outer surface is marked with somewhat regular, raised lines, about six of them in 5 mm. The best-preserved casts exhibit in the posterior half of the mesial sulcus a number of obscure radii. Anterior muscular scar sharply defined at the inner side, rather small, broad-oval or circular, occupying the middle two-fourths of the upper half of the anterior end. Posterior impression somewhat larger than the anterior, subcircular, with a narrow prolongation extending forward nearly parallel with the posterior cardinal margin. Pallial line distinct in the anterior half, consisting (on the casts) of a straight row

GONIOPHORA CARINATUS (Hall).

Plate XI., Fig. 23.

1847. *Modiolopsis carinatus* Hall, Pal. N. Y., vol. I., p. 160, pl. 35, figs. 11 *a–c*.

Description.—Shell small, subovate in outline, angular posteriorly. Anterior margin sharply rounded; basal margin nearly straight or slightly convex; postero-basal extremity acutely angular; posterior margin obliquely truncate, meeting the hinge-line in an obtusely rounded angle; cardinal margin straight, subparallel with the basal margin. Beaks small, incurved, elevated above the hinge-line, situated at about the anterior fourth of the total length of the shell. Umbonal ridge usually describing a slight, sigmoidal curve, sharply angular or carinate; the post-umbonal slope concave, sometimes with a slight, nearly-obsolete ridge extending from the beak to the middle of the truncate posterior margin. Antero-basal slope convex, with a slight, ill-defined, shallow sinus extending from the beak obliquely backward to near the middle of the basal margin. Surface marked by rather strong, more or less irregular, concentric lines of growth.

The dimensions of the largest specimens observed, a left valve, are: length, 14 mm.; height, 7 mm.; convexity, 3.5 mm.

Remarks.—This little shell is rather uncommon in the Trenton fauna of New Jersey, but may be easily distinguished from any of its associates by its strongly-carinate umbonal ridge. It was originally described as a species of *Modiolopsis,* but it clearly does not belong in that genus, and there seems to be no reason for considering it to be generically distinct from *Goniophora,* which is more characteristically a Devonian genus.

AMPHINURA.

CHITON? sp.

Plate XIII., Figs. 9–10.

A single plate, probably the posterior terminal one, has been observed in the New Jersey collections, which probably belongs to one of the Chitons. Its true generic reference is uncertain, but doubtless it is not a member of the recent genus *Chiton*. It is subpentago in outline, obtusely angular in front, its posterior margin slight sinuate. Along the median line it is quite sharply rounded towa the apex, but becomes more broadly rounded posteriorly, with a sligh longitudinal, median groove, becoming stronger posteriorly. The sid slope down to the lateral margins with a gentle convexity. The su face is smooth.

Its dimensions are: length, 7 mm.; breadth, 7 mm.

GASTROPODA.

ARCHINACELLA PATELLIFORMIS (Hall).

Plate XII., Figs. 1–2.

1847. *Carinaropsis patelliformis* Hall, Pal N. Y., vol. I., p. 183, p 40, figs. 2*a–b*.

Description.—Shell subovate in outline, slightly narrowed posteriorly, patelliform, obliquely depressed, conical, obtusely subcarinate along the median, dorsal line; the apex situated anteriorly, slightly incurved and extended in a line with or a little beyond the margin. Surface marked by fine, concentric lines of growth.

The dimensions of a nearly-perfect specimen are: length, 11 mm.; breadth, 9 mm.; convexity, 4 mm.

CYRTOLITES ORNATUS var. MINOR U. & S.

the dorsal slopes gently convex and distinctly undulated by strong, slightly-curved, transverse furrows and subangular ridges; the ventral or umbilical slopes almost flat and usually without undulations; ventral side with a sharp, central furrow for the reception of the dorsal carina of the preceding volution. Umbilicus well defined, wide and deep, the edge wavy. Aperture a little wider than high, the height a little more than half the greatest diameter of the shell, more or less rhombic-subquadrate in outline.

The dimensions of the best-preserved specimen observed are: greatest diameter, 11.5 mm.; width of aperture, 8.5 mm.

Remarks.—This variety of ***Cyrtolites ornatus*** **differs only from the** typical form of the species in its smaller size. The variety is the older form, being known only from the Trenton, while the larger, more typical form occurs in younger beds. But few individuals have been observed in the New Jersey collections, and all of these are internal casts, so that the delicate surface markings of the species cannot be seen. These markings consist of delicate, raised lines, running almost straight across the volutions, with short, connecting lines arranged alternately.

PROTOWARTHIA CANCELLATA (Hall).

Plate XII., Figs. 3–5.

1897. *Protowarthia cancellata* U. & S., Pal. Minn., pt. II., p. 872, pl. 63, figs. 1–14.

Description.—Shell of medium size, subglobose, close coiled, with no umbilicus when the shell is preserved, but with a small one in the casts. In immature specimens the dorsum of the outer volution is rather sharply rounded, but with increasing age it becomes more broadly rounded, losing entirely the obscure carination of the younger shells. Sinus shallow, rounded; the lateral margins of the aperture on either side of the sinus regularly and rather gently convex. Aperture wider than high, subsemi-circular in outline. On the larger internal casts one or more rather broad and shallow, rounded, transverse, wrinkle-like depressions are frequently present near the aperture and parallel with the apertural margin.

The dimensions of a large specimen are: maximum diameter, 2 mm.; width of aperture, 18 mm.

Remarks.—In none of the New Jersey specimens have the delicat surface markings of this species been observed. These marking should consist of fine transverse and still-finer revolving lines, givin to the surface of the shell a cancellated appearance.

TETRANOTA BIDORSATA (Hall).

Plate XII., Figs. 18–19.

1847. *Bucania bidorsata* Hall, Pal. N. Y., vol. I., p. 186. pl. 4 figs. 8 *a–g*.

1897. *Tetranota bidorsata* U. & S., Pal. Minn., pt. II., p. 877, p 65, figs. 10–18.

Description.—"Shell usually about 12 mm. in height, but the heigh may exceed 20 mm., and occasionally reaches 25 mm.; volutions two and a half to three and a half, vertically compressed, sublunate in section; the width for the inner volutions or in young specimens a little greater than twice the height; in old examples the increasing altitude of the centro-dorsal ridges causes the width just behind the aperture to be proportionally somewhat less; umbilicus large, deep, rather sharply defined, the width generally about half the greatest diameter of the shell; the latter dimension is to the greatest width of the aperture about as three is to four. Aperture somewhat abruptly expanded laterally, the height and width about as three is to seven;

groove, which slopes down to the angular or sharply-rounded side of the volution. While the central pair of ridges increases in prominence, the lateral pair becomes more and more indistinct on the last volution, till, at the apertural margin, they are scarcely distinguishable—at any rate, this is true of casts. The transverse surface markings are prominent, regular, visible to the unassisted eye, about three in 1 mm.; the course of the striæ from the umbilicus is at first nearly straight across, and it is only in the centro-lateral grooves that they curve backward very strongly. When the characters of the external layer are preserved, these very fine, short lines are to be seen crossing the transverse lines rectangularly."—*Ulrich and Scofield.*

BUCANIA PUNCTIFRONS (Emm.).

Plate XII., Figs. 10–12.

1842. *Bellerophon punctifrons* Emm., Geol. Rep. 2d Dist. N. Y., p. 392, fig. 5.
1847. *Bucania punctifrons* Hall, Pal. N. Y., vol. I., p. 187, pl. 40 *A*, figs. 1 *a–e*.
1897. *Bucania punctifrons* U. & S., Pal. Minn., pt. II., p. 894, pl. 67, figs. 41–44.

Description.—"Shell rather small, probably not exceeding 20 mm. in height. Volutions three or four and a half, rounded on the back, subangular on the sides; umbilicus large, its width somewhat greater than half the height of the shell; aperture slightly wider than high, subpentagonal. In a transverse section the volutions are semi-circular in the dorsal half, with the umbilical slopes almost straight and the ventral side broadly indented by the preceding whorl. The width of the last volution expands from 6 mm. to 12 mm. in a specimen 18 mm. high. In the same specimen the slit has a length of 16.5 mm. and a width of 0.7 mm. The slit-band is concave, bordered on each side by a delicate line and crossed by numerous fine lunulæ. On each side of the slit and band the whole exposed surface is covered by a strong and very sharply-defined network, the deep meshes of which are so arranged that they form rows running in two directions, one almost directly across the volutions, the other obliquely forward and outward from the band. Finally, in certain lights, a third arrangement of the meshes will be observed, namely, in a series passing obliquely forward from the sides to the slit-band. The last direction is approximately at right angles to certain more or less distinct lines or varices of growth, which interrupt the regularity of the network on old examples."—*Ulrich and Scofield.*

PHRAGMOLITES COMPRESSUS Con.

Plate XII., Figs. 16–17.

1838. *Phragmolites compressus* Con., Ann. Rep. Geol. Surv. N. Y., p. 119.

1847. *Cyrtolites compressus* Hall, Pal. N. Y., vol. I., p. 188, pl. 40 *A,* figs. 2 *a–f.*

Shell discoid. Volutions two or three, slightly embracing, strongly carinate upon the dorsum, subtriangular in cross-section, wider than high; the sides moderately convex from the base of the carina to the margin of the umbilicus, where they are bent abruptly inward at nearly right angles to the plane of the shell; umbilicus from two-fifths to one-half the total diameter of the shell. The lateral surfaces rather than with the Gasteropods, his type species cannot be mistaken. Under these conditions, the name *Phragmolites* is used in this place rather than *Conradella.*

OXYDISCUS SUBACUTUS Ulrich.

Plate XII., Figs. 8–9.

1897. *Oxydiscus subacutus* Ulrich, Pal. Minn., pt. II., p. 913, pl. 62, figs. 62–65, pl. 82, figs. 23–25.

Description.—"Shell lenticular; dorsum acutely carinated; greatest diameter from 15 mm. to 28 mm.; greatest thickness or width nearly one-half the diameter. Volutions three and one-half to four and one-half, thickest near the umbilicus, from which the surface ascends, first, with a gently convex, then with a concave slope to the sharp periphery; each volution embracing between one-third and one-half of the preceding one; umbilicus exposing all the whorls; its width somewhat less than one-third of the diameter of the shell; edge of umbilicus abrupt, subangular; aperture obcordate, indented below by the sharp dorsum of the perceding whorl; margin of aperture thin, in a side view with a strong, backward sweep; slit long, very narrow. Surface marked by fine and rather indistinct lines of growth."—*Ulrich.*

PTEROTHECA EXPANSA (Emm.)?

Plate XII., Fig. 35.

1842. *Delthyris expansus* Emmons, Geol. Rep. 2d Dist. N. Y., p. 397, figs. 109–112.

1861. *Clioderma expansa* Hall, 14th Ann. Rep. N. Y. State Cab. Nat. Hist., p. 98.

A single imperfect specimen, which may belong to this species, has been observed. It is a shell which, when complete, was subelliptical in outline and strongly carinate along its median line. Each lateral slope from the median line of the shell is at first abrupt to the base of the carina and is then gently convex to the lateral margins, with a single, shallow, rounded furrow extending from the apex obliquely to the postero-lateral margin.

The approximate dimensions of the shell must have been: length, 24 mm.; width, 30 mm.

RAPHISTOMA PERACUTUM U. & S.

Plate XII., Figs. 22–23.

1897. *Raphistoma peracutum* U. & S., Pal. Minn., pt. II., p. 940, pl. 68, figs. 1–6.

Description.—"Shell small, not known to exceed 12 mm. in diameter, consisting of three or three and one-half whorls, flat above, rounded below; periphery very sharp and thin; umbilicus equaling a little more than a fourth of the greatest diameter, its edge narrowly rounded; height of shell very slightly exceeding a fourth of the width. Surface marked on the flat, upper side with very fine, subequal striæ, sweeping on the whole rather strongly backward from the suture. About a third of the width of a whorl from the suture the striæ are interrupted by a delicate, revolving line. Between the latter and the extreme edge of the peripheral carina the striæ make

LOPHOSPIRA MEDIALIS U. & S.

Plate XII., Fig. 28.

1897. *Lophospira medialis* U. & S., Pal. Minn., pt. II., p. 973, pl. 73, figs. 23–29.

Description.—"Height 12 to 22 mm.; apical angle 58° to 70°, the average about 63°. Volutions six or seven, all contiguous, somewhat depressed, rounded below; upper slope nearly flat, generally a little concave in the outer half and gently convex toward the suture, occasionally convex enough to form an obscure, subsutural angulation; lower carina becoming less distinct with age, never strong, generally quite indistinct; between it and the prominent peripheral carina, which carries the rounded band, the outline is more or less concave; umbilicus small, but always present. Surface markings rather strong, lamellose, strongly curved backward, often gathered into undulating groups near the umbilicus."—*Ulrich and Scofield.*

LOPHOSPIRA OWENI U. & S.

Plate XII., Fig. 34.

1897. *Lophospira oweni* U. & S., Pal. Minn., pt. II., p. 980, pl. 73, figs. 41–45.

Description.—"Height 25 to 36 mm.; apical angle 59° to 62°. Volutions six or seven, the first very minute, decidedly angular. Peripheral band prominent, thick and rounded, sometimes margined by a delicate line on each side. Upper slope concave, except near the suture, where there is usually a broad, rounded ridge or carina; this ridge, however, becomes quite obsolete on the sixth or seventh volution. Lower side sloping inward, scarcely ventricose, the outline being first concave, next convex, then straight or concave and finally convex again, there being a peculiar swelling just behind the minute umbilicus. The first convexity beneath the peripheral band represents the lower carina of *L. perangulata* and other species, and in young shells it is sharp enough to be called a carina, but as growth proceeds it becomes more and more obtuse. Aperture straight at th inner margin, somewhat narrowly produced at the lower angle. Surface markings rarely preserved; whenever preserved, they consist o rather distant, delicate, sublamellose striæ, with very fine lines between them, all curving backward strongly to the peripheral band."—*Ulrich and Scofield.*

Remarks.—This species is rare in the Black River horizon of the Trenton formation at Jacksonburg, and has not been observed in a satisfactory condition of preservation to exhibit all its characteristics. There seems to be no doubt, however, that the New Jersey shell is identical with the species which has been described as *L. oweni* from Minnesota.

LIOSPIRA MICULA (Hall).

Plate XII., Figs. 24–25.

1862. *Pleurotomaria micula* Hall, Geol. Rep. Wis., vol. I., p. 55, fig. 4 (no description).

1897. *Liospira micula* U. & S., Pal. Minn., pt. II., p. 994, pl. 68, figs. 24–29.

Description.—Shell small, discoidal-lenticular, consisting of about four volutions. The umbilicus filled by a perfectly-smooth, rather distinctly outlined, concave, reflexed callosity of the inner lip. The sutures very shallow; the spire forming an almost continuous, even slope from the apex to the periphery, the apical angle being from 120° to 127°. The periphery of the outer volution is sharply angular in the casts, but is more rounded when the shell is preserved. The different from the specimens here referred to *L. micula*. *Pleurotomaria micula* was illustrated, but not described, by Hall, the specimens coming from the Trenton formation in Wisconsin. The species was afterwards reidentified and described by Ulrich and Scofield in their Minnesota report, and it has been recognized as a rather common Trenton form in the Mississippi valley. The real status of *L. subtilistriata* still remains in doubt. It is possible that it is really a minute species, and that the large specimens illustrated for the species are specifically distinct from the minute specimens indicated in the description, and should be referred to *L. micula*. It is also possible that the small individuals mentioned by Hall are only the young of the larger one, and that the two supposed species, *subtilistriata* and *micula*, are one and the same, in which case the name *subtilistriata*, having priority, would be the proper designation of the species.

HORMOTOMA SALTERI Ulrich.

Plate XII., Fig. 29.

1897. *Hormotoma salteri* Ulr., Pal. Minn., pt. II., p. 1016, pl. 70, figs. 44–51.

Description.—Height 12 to 40 mm.; apical angle 24° to 25°. Volutions nine or ten in large individuals, rounded, with a central, flattened or slightly concave, revolving band, which is bordered on each side by a delicate, raised line; not recognizable on the internal casts. Suture simple, deep. Lines of growth fine, bending strongly backward from the suture to the band, and beneath this curving very strongly forward again. Aperture nearly circular, the outer lip deeply notched at the revolving band.

Remarks.—This species has been separated from the common *H. gracilis* (Hall) by Ulrich because of its greater apical angle, the typical form of *H. gracilis* having an apical angle of but about 18°. In all other respects the two species are essentially alike, and the specimens now referred to *H. salteri* have always previously been referred to *H. gracilis*. The species is rather common in the Trenton limestone of New Jersey in some localities, and in none of those observed is the apical angle less than 24°, and in but few is it as much as 25°; the great majority of species measures exactly 24° The New Jersey specimens usually lose their surface markings in being removed from their limestone matrix, and are usually broken up to such an extent that it is rare to secure fragments more than 12 or 15 mm. in length.

HELICOTOMA sp.

In the faunas of the lower beds of the Jacksonburg section, and elsewhere, several specimens belonging to one or more species of the genus *Helicotoma* have been noticed. All of them are badly crushed and are in such a condition that they cannot be specifically identified.

ECCYLIOMPHALUS TRENTONENSIS (Conrad).

Plate XII., Figs. 20–21.

1842. *Cyrtolites trentonensis* Conrad, Jour. Acad. Nat. Sci. Phil., vol. VIII., p. 270, pl. 17, fig. 4.

1847. *Cyrtolites trentonensis* Hall, Pal. N. Y., vol. I., p. 189, pl. 40 *A*, figs. 3 *a–d*, pl. 41, figs. 1 *a–c*.

Description.—Shell consisting of less than one volution, increasing gradually in size from the apex, coiled in one plane. Cross-section angularly subovate. Ventral side of the shell convex from the periphery to the inner margin; the periphery rather sharply rounded; about midway between it and the inner margin, on the dorsal side of the shell, is an angular, subcarinate ridge, the space between this ridge as a member of the genus *Eccyliomphalus* by Ulrich and Scofield, but the New Jersey specimens are certainly cogeneric with the species referred by them to this genus, and there also seems to be no question as to their identity with the shells described as *Cyrtolites trentonensis* from New York.

ECCYLIOMPHALUS CONTIGUUS Ulrich.

Plate XII., Figs. 13–15.

1897. *Eccyliomphalus contiguus* Ulrich, Pal. Minn., pt. II., p. 1037, pl. 74, figs. 48–52.

Description.—"Shell 12 to 30 mm. in diameter, 7 to 16 mm. in height, consisting of three or four rapidly-enlarging, contiguous whorls, coiled so as to leave a deep umbilicus, in which from a third to a half of each of the inner whorls is visible; whorls subovate in section, higher than wide, somewhat narrowly rounded in the outer half of the upper surface. On the upper side the inner whorls may be sunken slightly beneath or raised above the level of the last; innermost whorl with a free termination. Mouth obliquely subovate, the margin rather deeply notched above, broadly curved forward on the outer side and gently sinuate below. Surface markings somewhat irregular and coarse, parallel with the edge of the mouth."—*Ulrich.*

Remarks.—A single specimen from the Trenton limestone of New Jersey seems to be identical or at least closely allied to *E. contiguus,* described by Ulrich from the Stone's River group of Tennessee. It is smaller than the dimensions recorded for the Tennessee shell, having a maximum diameter of only about 6.5 mm., but this may be due to the immaturity of the shell. The shell itself is apparently entirely removed from the specimen, so that the surface markings and the outline of the aperture cannot be certainly determined, but the general contour of the shell agrees closely with Ulrich's figure 52, except that the New Jersey shell is slightly lower. If sufficient material could be examined, it is possible that the New Jersey specimens would constitute a species distinct from, but closely allied to, this species described from Tennessee.

CYCLONEMA MONTREALENSIS Bill.

Plate XII., Fig. 33.

1865. *Cyclonema montrealensis* Bill., Pal. Foss., vol. I., p. 30, fig. 28, p. 29.

Description.—Shell with the height and width about equal, the diameter of full-grown individuals being from 20 to 30 mm. Apical angle about 90°. Volutions about four, rather rapidly enlarging and strongly convex. Suture distinct. Aperture subcircular. Surface marked by strong, revolving lines, .5 to 1 mm. apart, and by much finer, oblique, transverse lines.

Remarks.—All the specimens of this species which have been studied are more or less crushed, so that the amount of variation of the apical angle cannot be determined, though it is probably never less than 90°. The apex of all the specimens seen is imperfect, so that there may have been one or two additional volutions in the perfect shells.

HOLOPEA SYMMETRICA Hall.

Plate XII., Figs. 26–27.

1847. *Holopea symmetrica* Hall, Pal. N. Y., vol. I., p. 170, pl. 37, fig. 1.

HOLOPEA PARVULA Ulrich.

Plate XII., Fig. 30.

1897. *Holopea parvula* Ulrich, Pal. Minn., pt. II., p. 1067, pl. 79, fig. 19 (*H. pyrene* var. *parvula* in explanation of plate).

Description.—"Shell small, 6 to 10 mm. in width, the height equaling about three-fourths of the width; spire depressed-conical; whorls four, including two very small ones at the apex, neatly rounded, subcircular in section; suture distinct, very slightly canaliculate; umbilicus large, equaling about one-fourth of the diameter of the shell; aperture moderately oblique, rounded, slightly modified above by the preceding whorl; surface with very fine, obscure lines of growth, and on the latter half of the body whorl a number of more or less obscure undulations running parallel with the apertural margin."—*Ulrich.*

Remarks.—Among the New Jersey specimens a single one seems to be a member of this species. It is imperfectly preserved, but, in so far as its characters can be determined, it does not differ essentially from Ulrich's description, which has been copied above. The umbilicus is so filled with the matrix that its size cannot be determined, the surface marking cannot be seen, and none of the obscure undulations mentioned in the description can be detected.

HOLOPEA SUPRAPLANA U. & S.?

Plate XII., Figs. 31–32.

1897. *Holopea supraplana* U. & S., Pal. Minn., pt. II., p. 1068, pl. 79, figs. 27–28.

A single imperfect specimen from New Jersey, from which all the inner whorls are missing, seems to be referable to this species. It is characterized by its rapidly-expanding, outer volution, the vertical expansion being much the most pronounced, so that the aperture is nearly twice as high as it is wide.

PTEROPODA.

CONULARIA TRENTONENSIS Hall.

Plate XIII., Figs. 7–8.

1847. *Conularia trentonensis* Hall, Pal. N. Y., vol. I., p. 222, pl. 58, figs. 1 *a–f*.

Description.—Shell of medium size, pyramidal in form, quadrangular in cross-section, the sides diverging from the apex at an angle of about 25°. The sides slightly convex, the angles furrowed. Each side marked by a series of angular, transverse costæ, which are directed obliquely forward toward the aperture from each lateral margin, forming a rounded angle of about 130° at the median line; from two to four of these costæ occupy the space of 1 mm., being closer together and finer near the apex of the shell and becoming progressively coarser towards the aperture. The furrows between the costæ are wider than the ridges, rounded in the bottom, and are crossed at right angles by fine, raised bars joining adjacent costæ, which are somewhat closer together than the costæ themselves and not quite as high.

The dimensions of a specimen which is somewhat incomplete at the apex are: length, 38 mm.; diameter at aperture, 18 mm.

Remarks.—This is the only species of *Conularia* which has been recognized in the Trenton limestone of New Jersey. It is the common Trenton species of the genus which occurs in New York and other [redacted] subcentral, small. Surface of the shell without annulations or ridges; marked by fine, crowded, horizontal lines, somewhat undulating or irregular, often running into one another, rounded on the summit and subimbricating, separated by low furrows and divided at irregular intervals by a furrow of more than average width. The horizontal lines and furrows are crossed by extremely fine, vertical lines, seen only under magnification."—*Clarke.*

Remarks.—Fragments of this species of *Orthoceras* are sometimes met with in the Trenton fauna of New Jersey. One specimen, which is possibly a member of the species, has a length of 75 mm., with a diameter of 21.5 mm. at the larger and 14 mm. at the smaller end. This specimen does not preserve the characteristic transverse markings of the shell, but they may have been eroded. It is marked, however, by a series of dull-colored, vertical bands about 1 mm. in breadth, separated by darker bands of about twice the width. A similar banding of the shell is noted by Clarke, and is considered by him as being a trace of original color lines in the living shell.

ORTHOCERAS TENUITEXTUM (Hall).

Plate XIII., Figs. 3-4.

1847. *Endoceras proteiforme* var. *tenuitextum* Hall, Pal. N. Y., vol. I., p. 210, pl. 45, figs. 2-5.

Description.—Shell straight, gradually expanding. Sutures, septa and sipho not observed. The surface is marked by a series of fine, angular, longitudinal, raised lines, about three or four occupying the space of 1 mm., and also by transverse, raised lines, more rounded and a little closer together than the longitudinal markings, giving to the entire surface a fine, regular, reticulate ornamentation.

The dimensions of the best specimen observed are: length, 54 mm.; diameter at larger end, 13 mm.; diameter at smaller end, 5.5 mm. This specimen is somewhat compressed, so that the diameters given above are a little too great.

Remarks.—Fragments of this shell occur with the last, but they can always be distinguished by their very different surface markings. In general size and proportions the two species are much alike.

ORTHOCERAS sp. undet.

Plate XIII., Fig. 6.

A single imperfect specimen of an *Orthoceras* in the collection is apparently different from either of the two preceding species. The shell expands more rapidly and seems to be marked by obscure annulations. The specimen is slightly curved, and if this feature is not accidental, it should, perhaps, be referred to the genus *Cyrtoceras.*

The dimensions of the specimen are: length, 25 mm.; diameter at larger end, 8 mm.; diameter at smaller end, 3 mm.

CAMEROCERAS PROTEIFORME (Hall).

Plate XIII., Fig. 5.

1847. *Endoceras proteiforme* Hall, Pal. N. Y., vol. I., p. 208, pl. 46, figs. 1 *a–b*, 2 (?), pl. 48, figs. 1, 2 (?), 3, 4, pl. 49, figs.

ARTHROPODA.

TRILOBITA.

HARPINA OTTAWENSIS (Bill.).

Plate XIV., Figs. 1–2.

1865. *Harpes ottawaensis* Bill., Pal. Foss., vol. 1, p. 182, fig. 165.
1897. *Harpina,* cf. *H. ottawensis* Clarke, Pal. Minn., pt. II., p. 757, fig. 79.

Description.—"Head strongly convex, with a wide, punctured border, which extends backward to about the thirteenth segment of the thorax. If a line be drawn across touching the posterior edge of the neck segment, the contour in front of that line is nearly a perfect semicircle. Glabella regularly conical, its length about five-ninths that of the head; posterior furrows distinct, entering at about one-half the distance from the ocular ridge to the posterior margin of the neck segment, thence running obliquely inward and backwards at an angle of about 45°, apparently not quite one-third the width; two anterior furrows on each side, represented by obscure pits; neck furrow narrow; neck segment convex, strongly elevated on the fixed cheeks. The eyes [ocelli] are small and situated on a line drawn across the glabella at the anterior fourth; ocular ridge well defined, smooth, prolonged, with a backward curve outside of the eye. Thorax a little more than half the width of the head; the axis strongly convex and gradually tapering backwards; side lobes flat; pluræ with a wide groove along the middle, a small portion of their outer extremities turned backward. Surface of thorax, glabella and a subreniform space on each side of the base of the glabella smooth; the border with circular punctures about [0.2 mm.] in width, and separated by smooth, rounded interspaces half their own width; the punctures larger and more distant at the inner edge of the border; on the elevated part of the cheeks they have a subreticulated arrangement."—*Billings.*

Remarks.—Fragments of the head of this species are not uncommon at Jacksonburg, but no perfect individual or even a perfect head has been observed. The commonest occurrence of the species is as the impression of the wide, punctured, marginal border of the head, these specimens being similar to the one illustrated by Clarke from Minnesota.

TRINUCLEUS CONCENTRICUS (Eaton).

Plate XIV., Figs. 3-4.

1847. *Trinucleus concentricus* Hall, Pal. N. Y., vol. I., p. 249, pl. 65, figs. 4 *a–c*.

Description.—Head semi-circular or subcrescent-form in outline, the genal angles either destitute of spines or produced into long, slender, straight spines. Glabella smooth, very prominent, ovoid in outline, the widest portion being in front, with a short, blunt spine posteriorly; cheeks smooth, prominent, but depressed considerably below the glabella, from which they are separated by a well-defined dorsal furrow; eyes wanting. The entire anterior and lateral margins of the head are surrounded by a broad, somewhat flattened or concave border, which is marked in front by from three to five concentric rows of deep, rounded pits; one or two additional rows are introduced on the sides, and toward the genal angles the pits often become irregularly scattered.

The thorax and pygidium have not been observed in New Jersey.

The dimensions of one of the best specimens observed, a nearly-complete head, are: length, 10 mm.; width, 15 mm.; convexity, 6 mm.

tion nearly obsolete. Head subtriangular to semi-elliptical in outline, convex, slightly flattened in front; the anterior margin rather sharply rounded; facial sutures meeting at an angle, at or just behind the frontal margin, from this point they describe a broad, subarcuate curve, and, after passing around the eyes, they curve outward and then downward, intersecting the posterior margin at some distance outside of the eyes; glabella obscurely defined and more obscurely lobed; occipital furrow and segment obsolete; free cheeks marked by an intramarginal furrow, above which their general surface is elevated into a more or less conspicuous node, crowned by the eye. Thorax with a broad axial lobe, occupying more than one-third the width, consisting of eight segments. Pygidium subtriangular in outline, of nearly the same size and shape as the head, its lobation very obscure, especially in the larger individuals, the dorsal furrows being hardly distinguishable; axis much narrower at its anterior extremity than the axis of the thorax, tapering rapidly to the obtusely rounded posterior extremity, which lies at about one-fourth the length of the pygidium from the posterior margin; pluræ convex, smooth in the larger individuals, but in younger ones marked by about ten obscure segments, which also continue across the axis; the entire margin of the pygidium, except where it joins the thorax, bordered by a rather broad, slightly depressed, marginal border; the anterior, lateral angles bent abruptly downward.

Remarks.—No complete individuals have been observed, but fragments of heads, pygidia and thoracic segments of this species are not uncommon in the Trenton limestone of New Jersey, some of them indicating individuals which must have had a total length of over 150 mm.

PTYCHOPYGE JERSEYENSIS n. sp.

Plate XIV., Fig. 16.

A single imperfect pygidium from Jacksonburg is apparently referable to this genus, and as it can be referred to none of the described species, the above name is proposed for it. The general form of the pygidium is semi-elliptical. The pluræ are convex near the axis, becoming concave in the outer half; they are marked by four well-defined furrows, which extend almost to the margin. The segments between the furrows are broad and flat. The axis is apparently unsegmented, though this cannot be stated with certainty, because of the imperfect condition of the specimen.

BUMASTUS TRENTONENSIS (Emm.).

Plate XIV., Figs. 8–13.

1842. *Illænus trentonensis* Emm., Geol. N. Y., Rep. on 2d Dist., p. 39, fig. 3.

1897. *Bumastus trentonensis* Clarke, Pal. Minn., pt. II., p. 718, figs. 30–35.

Description.—Head strongly convex, subsemi-circular in outline, not trilobate, and with no prominences save the eyes, which are located posteriorly, well toward the lateral margins. A pair of longitudinally elongate, sublunate depressions are situated on a transverse line joining the eyes, about half way between the eyes and the median line of the head. These depressions are slight or almost obsolete upon the exterior of the test, being much more strongly marked upon the casts. Aside from these depressions and a few fine lines near the anterior margin and running parallel with it, the test of the head is perfectly smooth. The pygidium is smooth throughout, not trilobate, resembling the head in size and general outline. Nine thoracic segments are present in the only specimen observed in which they are preserved.

The dimensions of a rather small specimen are: total length of body, 20 mm.; breadth, 10 mm.; length of head, 8 mm.; length of thorax, 6 mm.; length of pygidium, 6 mm.

Remarks.—This species is one of the commonest trilobites in the

BUMASTUS TRANSVERSALIS n. sp.

Plate XIV., Fig. 14.

Description.—Head convex, subelliptical in outline, not trilobate, much wider than long; the eyes situated posteriorly near the lateral margins. Test smooth, with a pair of longitudinally elongate, sublunate depressions on the transverse line between the eyes, about midway between the eyes and the median line of the head. Pygidium similar to the head in size and outline, perfectly smooth throughout. The complete thorax unknown.

The dimensions of one of the type specimens are: breadth of head between eyes, 13.5 mm.; length of head, 6 mm.; breadth of pygidium, 13 mm.; length of pygidium, 6 mm.

Remarks.—This species resembles *B. trentonensis,* but is proportionately very much broader; in all other respects the two species are alike. It has only been observed in the lower or Black River horizon of the Trenton limestone.

BUMASTUS ELONGATUS n. sp.

Plate XIV., Fig. 15.

At a single locality south of Newton a species of *Bumastus* has been found in the Trenton limestone which resembles *B. trentonensis* in all respects except in the much greater proportional length of the parts. A nearly-perfect pygidium having a length of 13 mm. and a width of 12 mm. is illustrated. Associated with this elongate pygidium there are fragments of heads which also have similar elongate proportions.

PROETUS LATIMARGINATUS n. sp.

Plate XIV., Figs. 17–24.

Description.—Head sublunate in outline, the genal angles produced into long, sharp spines. Glabella elevated, broadly subconical, rounded in front; lateral furrows nearly obsolete exteriorly, but sometimes their position is indicated by dark lines on the surface, which seem to indicate an internal thickening of the test; the two anterior pairs are short and lie in front of the eye-lobes; they are close together, and are directed obliquely backward from the margin of the glabella; the posterior pair are more conspicuous than the others, and are sometimes marked by slight depressions; they are situated a little in front of the middle of the eye-lobes, and are directed obliquely backward from the margin of the glabella, becoming more curved posteriorly, joining the occipital furrow at nearly right angles. The dorsal furrow well defined throughout. Occipital furrow sharply impressed, deeper than the dorsal furrow. Occipital segment with sub-parallel margins, scarcely as highly elevated as the glabella, marked by a small, rounded tubercle at its central point. Palpebral lobes of moderate width, subsemi-circular in outline, depressed below the level of the glabella. Facial sutures curving into the margin of the glabella, both in front and behind the palpebral lobes; posteriorly they intersect the margin of the head close to the axial lobe; in front of the palpebral lobes they curve outward nearly to the margin of the head, where they make a rather sharp bend and recurve inwardly, intersecting the anterior margin at some distance from its median point. Anterior limb of the cranidium broad, with a convex marginal border, between which and the glabella there is a rather broad, shallow, concave furrow. Free cheeks depressed-convex, with the eyes abruptly elevated, marked by a rather broad marginal border on both the lateral and posterior margins, on the inner side of which there is a rather sharply impressed furrow. Pygidium small, sub-semi-circular in outline; the posterior margin regularly rounded;

in the New Jersey specimens. The small tubercle upon the occipital segment is not mentioned in the description of *P. parviusculus,* nor is it shown in the illustration. Another species allied to this one is *P. alaricus* Bill., from the Upper Ordovician of Canada.

PROETUS BREVIMARGINATUS n. sp.

Plate XV., Figs. 1–7.

This species resembles the last in general form and size, but the heads may always be distinguished by the greater convexity of the glabella, with a deeply-impressed posterior pair of lateral, glabellar furrows and two anterior pairs of slightly-impressed furrows, also by the much shorter frontal border of the cranidium. The proportions of the head are broader, with broader free cheeks, and the tubercle upon the occipital segment is usually less conspicuous than in *P. latimarginatus.* The pygidium which is believed to belong to this species has a broader axis, more broadly rounded posteriorly, than that of *P. latimarginatus,* and has a less number of segments on both axis and pluræ.

The two species occur associated together in the same strata, and are about equally abundant.

CYPHASPIS TRENTONENSIS n. sp.

Plate XV., Figs. 8–10.

Description.—Glabella bounded on all sides by a deep furrow; the median lobe ovate or subpyriform, narrower behind, strongly arched, both longitudinally and transversely; basal lobes prominent, less than one-half the length of the median lobe and separated from it by deep furrows. The anterior marginal border of the cranidium narrow, bounded internally by a sharply impressed marginal furrow. Between the marginal furrow and the dorsal furrow bounding the glabella is a convex band, broader than the marginal border, which extends backward to the occipital furrow and surrounds the glabella, except posteriorly. The palpebral lobes are rather prominent and elevated, but do not rise as high as the glabella. Occipital furrow rather deeply depressed. Occipital segment broader than the furrow, produced posteriorly at its median point into a short, blunt spine or tubercle. Surface of the median and basal lobes of the glabella, the posterior portion of the band surrounding the glabella and the occipital segment, covered with minute tubercles, which are most abundant upon the glabella. The band between the dorsal and marginal furrows, in front of the glabella, has a closely-pitted surface. The anterior marginal border, the palpebral lobes and the bottom of all the furrows are smooth.

The free cheeks, thorax and pygidium are unknown.

The dimensions of the largest specimen observed are: total length of head, 4.75 mm.; width between palpebral lobes, 5 mm.; length of glabella, 3 mm.; width of glabella, 2.33 mm.

Remarks.—This species is closely allied to *C. planifrons* Eich. of Russia, as described by Fr. Schmidt.[*] It differs from that species in the absence of the abrupt descent of the glabella posteriorly into the occipital furrow, and in its different surface markings, the head of *C. planifrons* being covered throughout with scattered tubercles.

BRONTEUS LUNATUS Bill.

Plate XV., Figs. 14–16.

Remarks.—Only the pygidium of this species has been observed in New Jersey, but Billings' illustration of a complete individual is introduced to show the characters of the remaining portions of the body. In Billings' figure the broad, flat, posterior, axial rib of the pygidium is deeply divided for about one-half its length, although this division is not mentioned in the description of the species. In the New Jersey specimens no such bifurcation of this rib is noticeable, although just at the posterior margin of the pygidium there is the faintest suggestion of a median furrow.

The surface of the test is marked by exceedingly fine, raised, concentric lines, which arch forward in crossing the ribs of the pygidium.

ARGES TUBERCULATUS n. sp.

Plate XV., Figs. 11–13.

Description.—Cephalon subtriangular to subpentagonal in outline, flattened above, the eye-lobes prominent. Glabella flattened above, its median and lateral lobes, as well as the eye-lobes, having the same elevation, strongly curved downward in front; median lobe broadest in front, its anterior portion strongly convex and extending beyond the lateral lobes; the second pair of glabellar furrows obsolete, the posterior and anterior ones continuous, separating off a pair of subovate, lateral lobes, which are strongly convex in front, each of which is as broad anteriorly as the median lobe; the posterior lobes ill-defined. Dorsal furrows nearly as strong as the glabellar furrows anteriorly, but becoming fainter posteriorly and nearly obsolete before reaching the occipital furrow. Occipital furrow strongly impressed, curving forward medially. Occipital segment broad, its greatest breadth being back of the median lobe of the glabella. Fixed cheeks strongly convex. Eye-lobes prominent, placed about midway in the length of the head. Surface marked by scattered tubercles, which vary in size, being largest and most numerous upon the median lobe of the glabella. Free cheeks, thorax and pygidium unknown.

In the best-preserved specimen the length of the head is 6 mm., the breadth between the eyes being 9 mm.

Remarks.—But one other member of the genus *Arges* has been recognized in the Ordovician strata of America, *Arges westenbergensis* var. *paulianus** from Minnesota. The New Jersey specimens differ

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* Pal. Minn., pt. II., p. 744.

from this species in the more angular outline of the head, the r
prominent eye-lobes, the flattened dorsal surface and the much bro
occipital ring. Our species also occurs at a somewhat lower hor
than those from Minnesota, being in the Black River horizon of
Trenton limestone as it occurs in New Jersey.

PLATYMETOPUS TRENTONENSIS (Con.).

Plate XV., Figs. 17–19.

1842. *Asaphus? trentonensis* Con., Jour. Acad. Nat. Sci. Phil.,
VIII., p. 277, pl. 16, fig. 10.

1847. *Platynotus trentonensis* Hall, Pal. N. Y., vol. I., p. 235
64, figs. 1 *a–d* (not 1 *e*).

1897. *Platymetopus trentonensis* Clarke, Pal. Minn., pt. II., p.

Description.—Head ventricose, the curve along the median
from the posterior to the anterior margins being very nearly a s
circle, subsemi-circular in outline, attaining a breadth of 35 o
mm. The glabella very large, occupying nearly the entire bre
of the cranidium, strongly protuberant in front; with a single
of glabellar furrows, which originate at the anterior, lateral
gins, and, after curving inward, then backward and then slig
outward again, forming something more than a semi-circle, they
the occipital furrow, dividing the glabella into three lobes;
frontal or median lobe is broad in front, becoming narrower
teriorly to a point back of the middle of the head, and then a
broadens out, becoming nearly as wide on the occipital furro

ODONTOPLEURA PARVULA (Walc.).?

Plate XV., Figs. 21-22.

1879. *Acidaspis parvula* Walcott, 31st Rep. N. Y. State Mus. Nat. Hist., p. 69.

1897. *Odontopleura parvula* Clarke, Pal. Minn., pt. II., p. 744, fig. 61.

Description.—Width of the cranidium along its posterior border 8 mm., width between the eyes 5.5 mm., the outline anterior to the eyes forming nearly a semi-circle. Glabella proportionally large, its greatest width 3.25 mm., subtriangular in outline; each member of the two pairs of glabellar lobes entirely isolated; frontal or median lobe reaching from the extreme anterior margin of the head to the occipital furrow, its sides parallel and straight, with a pair of minute lateral extensions just back of the anterior extremity, which may, perhaps, be considered as a rudimentary third pair of glabellar lobes; the posterior pair of glabellar lobes subelliptical in outline, with their long axes directed obliquely to the axis of the median lobe; the anterior pair about one-half the size of the posterior pair, nearly circular in outline and placed in the angles between the posterior pair and the median lobe. The glabellar furrows about as deeply impressed as the dorsal furrows. The occipital furrow broad and deep; the occipital segment narrower than the furrow, with a small tubercle in its centre. Fixed cheeks nearly as prominent in their median portion as the lateral lobes of the glabella; palpebral lobes minute, situated just in front of the occipital furrow; back of the palpebral lobes the cheek is abruptly depressed to its long, lateral extensions. From the occipital furrow forward to the antero-lateral margin of the median lobe of the glabella the fixed cheek is marked by a marginal furrow, which is nearly as deeply impressed as the dorsal and glabellar furrows. Whole surface marked by fine, circular tubercles of variable size. The free cheeks, thorax and pygidium unknown.

Remarks.—*Odontopleura parvula* was originally described by Walcott from the Trenton limestone of Trenton Falls, New York, but the description of the head is so meagre that, in the absence of illustrations, it cannot be certainly identified. The glabellar furows are said to be so slight that "the lateral lobes and cheeks are scarcely defined." This is certainly not the case in the specimen from New

Jersey. At a later date Clarke published an illustration of a specimen of the species from the type locality, but this figure shows much larger eyes than could have been present in the New Jersey specimen and the lateral margins of the median lobe of the glabella are not straight and parallel as in the specimen under consideration. The marginal border continuing around the anterior margin of the head, which is shown in Clarke's figure, is not present in the specimen from New Jersey. By reason of these differences it seems possible that the New Jersey trilobite should be considered as a distinct and undescribed species.

ENCRINURUS TRENTONENSIS Walc.

Plate XV., Figs. 26–27.

1897. *Encrinurus trentonensis* Walc., 31st Rep. N. Y. State Mus. Nat. Hist., p. 68 (p. 14 of reprints).

Description.—Pygidium subtriangular in outline, length and breadth nearly equal; the lateral margins straight or slightly concave; the posterior extremity sharply rounded or subangular. Axis narrow, with tapering sides, terminating within the posterior margin of the pygidium, with about twenty-five narrow segments in the larger individuals. In the best-preserved specimen observed the first, fourth, seventh, eleventh, fifteenth and nineteenth axial segments each bear a low, blunt tubercle at the median line of the axis, while some of the intertubercular segments become fainter and even almost obsolete in ut. Among the specimens of pygidia which have been observed there re some which are smaller and proportionately much broader, with smaller number of segments both on the axis and on the pluræ. The axial segments of these smaller specimens are intermittently tubercular as in the larger ones, and it is believed that they are only mmature individuals of the same species.

The original *E. trentonensis,* which was described from Wisconsin and Illinois, has never been illustrated, but the New Jersey specimens agree in general very closely with the description of the species. There is some difference in the arrangement of the tubercular segments of the axis, but the New Jersey specimens exhibit some variation in this respect among themselves; the important character seems to be the intermittence of the tubercular segments, and not the exact position of these segments.

The species is a close analog of *E. serbachi* Schm.* from Russia.

CALYMENE SENARIA Con.

Plate XV., Fig. 23.

1847. *Calymene senaria* Hall, Pal. N. Y., vol. I., p. 238, pl. 64, figs. 3 *a–n.*

Description.—Head sub-semi-circular or sublunate in outline, the anterior and lateral margins being more or less nearly regularly rounded, and the posterior broadly sinuous, with the posterior lateral extremities bluntly subangular or abruptly rounded. Free cheeks irregularly triangular in outline, with thick, rounded, lateral margins, defined by a distinct, rounded, marginal furrow, which is continuous with the furrow separating the anterior end of the glabella from the prominent, elevated, anterior margin of the head. Facial sutures originating just in front of the genal angles, passing obliquely forward and inward for a little more than half the distance to the eyes, then curving inward to the base of the eye-lobe, and, after passing around the eyes, extending forward and intersecting the anterior margin at points a little nearer together than the breadth between the eyes. Eyes small and rather prominent. Glabella more prominent than the cheeks and separated from them by deep, dorsal fur-

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* Rev. Ostbalt. Sil. Tril., pt. I., p. 229.

rows; about as wide behind as its length, including the occipital segment, much narrower in front; the frontal and three pairs of lateral, glabellar lobes separated by three pairs of glabellar furrows, of which the anterior pair is much the faintest and shortest, each member of the second pair extends about one-fourth the distance across the glabella, slightly curved posteriorly, the posterior pair deeper and wider than either of the others, each member extending about one-third of the distance across the glabella and directed obliquely backward. Occipital furrow deep and prominent, connecting with the dorsal furrows and less conspicuously with the marginal furrows of the posterior margin of the fixed cheeks, arching slightly forward at the middle of the glabella. Occipital segment well defined, arching a little forward, about as high as the most prominent portion of the glabella in front. Fixed cheeks convex, provided with a deep, broad furrow along their posterior margin.

Pygidium wider than long, more or less subtrigonal in outline, but with the anterior margin broadly rounded. Axis well defined, convex, extending nearly to the posterior margin, with five or six transverse segments, which grow fainter posteriorly. The pluræ convex, each with about five segments, which are furrowed distally.

Whole surface of the test minutely granular.

Remarks.—Fragments of this species are common in the Trenton fauna of New Jersey, but no complete individuals have been observed This species is most closely allied to the common Cincinnatian species of Southern Ohio and Indiana, which Clarke has referred to* *C. callicephala* Green. The Trenton species, however, can always be distinguished from it by the grooving of the segments of the pluræ outline, the eyes small. Facial suture starting at the lateral margin, and after extending inward toward the glabella, making a sharp turn forward just back of the eye, and after passing around the eye, curving gently forward, cutting the anterior margin of the head in front of the glabella. Glabella prominent, convex, broadest in front, extending nearly to the anterior margin of the head. Glabellar furrows well defined, but not extending across the glabella. The two anterior pairs straight, each portion extending over about one-fourth the width of the glabella. The third pair extending inward about as far as the other two, and then bending abruptly backward and joining the occipital furrow, leaving the posterior glabellar lobes more or less detached. Occipital furrow deep and well defined, arching a little forward upon the glabella, extended laterally upon the fixed cheeks nearly to the lateral margins, where it joins a marginal furrow just in front of the genal spine, which passes anteriorly. Occipital segment well defined. Dorsal furrow rather sharply impressed. Fixed cheeks convex, their posterior lateral angles extended into prominent, curved, genal spines. Whole surface of the head, except the dorsal, glabellar, occipital and marginal furrows, strongly granulose or papillose, with some scattered tubercles larger than the others.

Thorax and pygidium not recognized in the New Jersey collections.

Remarks.—This species is more or less abundant in the Trenton limestone throughout the United States wherever this formation occurs, but is rarely preserved, except in a fragmentary condition. The New Jersey material consists entirely of fragmentary portions of the head; in most cases the glabella alone being recognized. This need never be mistaken, however, even in its fragmentary condition, because of its peculiar granulose ornamentation.

PSEUDOSPHAEREXOCHUS TRENTONENSIS Clarke.

Plate XV., Figs. 24–25.

1897. *Pseudosphærexochus trentonensis* Clarke, Pal. Minn., pt. II., p. 734, figs. 53–54.

Description.—Glabella subhemispherical, a little wider than long, with three pairs of distinct glabellar furrows. The first pair is the shortest, originating close to the frontal margin, the length of each being about one-half the distance between their outer extremities measured in a straight line. The second pair are longer, parallel for about one-half their length with the first pair, then directed more strongly backward. The third pair are longer than the second, subparallel with them, but deflected abruptly backward at their extremities, where they are widened into a slight pit or excavation, not reaching the occipital furrow. The occipital segment is widest in the middle. The cheeks are but imperfectly preserved. The entire surface of the glabella is covered with low, distinct, scattered tubercles.

The dimensions are: length of glabella, 12.5 mm.; length of glabella and occipital segment, 14.5 mm.; width of glabella, 13.5 mm.

Remarks.—This species was originally described from the Middle Trenton limestone at Trenton Falls, New York. In New Jersey the species has been observed only in the Black River horizon of the formation, where it is associated with *Leperditia fabulites* and *Dalmanella subæquata*. *Cheirurus vulcanus* Bill.,* described from the "Quebec group," Cow Head, Newfoundland, and from Stanbridge, is a very similar species. It is possible that the two are identical, in which case the specific name, *vulcanus*, has priority.

PTERYGOMETOPUS CALLICEPHALUS (Hall).

Plate XV., Figs. 29–32.

lower than the first, directed obliquely forward; third pair of glabellar furrows directed toward the axis of the glabella for a short distance and then bending abruptly backward and joining the occipital furrow, leaving the small, basal glabellar lobes wholly detached. Occipital furrow rather deep and broad. Occipital segment rather broad, its elevation about even with the glabella in front, its posterior margin convex. Palpebral lobes prominent, their elevation being nearly that of the glabella, separated from the glabella by the deep dorsal furrow, and marked by a conspicuous furrow just within the border of the eye. Eyes large, lunate, their inner margins elevated nearly or quite to the height of the glabella, their anterior ends opposite the first glabellar furrows and their posterior ends reaching nearly to the occipital furrow. Cheeks, outside the eyes, sloping rather abruptly to the lateral margins of the head; marked along the posterior margin to a point about one-half the distance from the eye to the margin by the narrow, but rather sharply impressed, occipital furrow, whose distal extremity is rather abrupt; the lateral borders marked by an ill-defined marginal furrow, which originates at the outer extremity of occipital furrow, and, after passing forward nearly parallel with the margin, joins the dorsal furrow just in front of the eye.

Pygidium subtriangular in outline, rather abruptly rounded or subangular posteriorly. Axis prominent, but rather narrow, its margin slightly incurved and abruptly rounded behind, marked by from eight to ten somewhat sinuous annulations; the pluræ slightly flattened adjacent to the axis, but soon curving rather abruptly to the lateral margins, marked by about six grooved segments, with slight traces of others posteriorly.

Surface of the glabella, palpebral lobes, occipital segment and cheeks inside the marginal furrow distinctly pustulose, the little tubercles being more or less irregular in size; upon the cheeks outside the border of the eyes the pupillæ are much less conspicuous than upon the glabella and the marginal border is perfectly smooth. Pygidium unornamented, except by the grooves marking the segments, which do not extend entirely to the border, thus leaving a plain, perfectly smooth, narrow marginal border.

PTERYGOMETOPUS INTERMEDIUS (Walcott).?

Plate XV., Fig. 33.

1879. *Dalmanites intermedius* Walcott, 31st Rep. N. Y. State Mus. Nat. Hist., p. 69 (p. 16 of adv. sheets, 1877).

1897. *Pterygometopus intermedius* Clarke, Pal. Minn., pt. II., p. 727, figs. 45–47.

In some of the lower beds of the Jacksonburg section, below those containing *P. callicephalus,* the pygidium of another species of *Pterygometopus* sometimes occurs. These pygidia are longer and much more triangular in outline than those of *P. callicephalus* and are usually smaller. The sides of the axis are slightly concave inward, giving it a slightly constricted appearance near the centre of its length. The axis extends nearly to the posterior extremity of the pygidium, is rounded at its end, and has about twelve annulations, with sometimes faint traces of several additional ones. The pleuræ slope away abruptly from the axis, especially posteriorly, and are marked by eight ribs, the first two or three of which are usually slightly grooved.

The head of this species has not been observed, so that it cannot be identified with certainty as *P. intermedius,* but the characters of the pygidium approach more closely to that species than to any other.

of the valve as two is to three, the two extremities almost equally angular; height of ends about as three is to four, both obliquely truncate above, the anterior narrowly rounded in the middle; the posterior outline more broadly and evenly curved, though having the usual backward swing. Ventral edge of carapace obtuse, scarcely flattened, with a slight furrow on each side near the edge of the right valve, in which a row of minute punctæ is generally distinguishable; overlap extending all around the free edges, strongest ventrally; except in rare instances neither valve has a flange or flattened border, and when present, it is in all cases very narrow and undefined; dorsal edge somewhat thickened, especially upon the left side. Surface of valves smooth or very faintly pitted, rather evenly convex, with the greatest thickness somewhat beneath the centre; a low ridge-like thickening along the posterior half of the dorsal margin of the left valve is to be noticed. Eye tubercle just distinguishable in most cases, often not to be detected. On the inner surface, however, it is always marked by a distinct pit. Muscle spot not distinguishable externally, except when the specimens are weathered, but on the inner side it is often well marked and surrounded by fine, reticulating, radial lines, short dorsally, longest post-ventrally. On the inner side of the ventral edge of the right valve there are two rows of small papillæ, three to five each, the number seeming to increase with age. The purpose of the papillæ, one series of which occurs in the anterior third, the other in the posterior, evidently was to prevent undue overlapping of the valves by presenting an obstacle to the entering ventral edge of the left valve."—*Ulrich.*

LEPERDITELLA ORNATA n. sp.

Plate XIII., Figs. 13-15.

Carapace subelliptical; length of a large specimen, 3 mm.; height, 2 mm.; thickness, 1.7 mm.; length of hinge line, 1.7 mm. Valves equally convex, greatest thickness below the middle. Free margin of the right valve abruptly inflexed, with a row of minute tubercles upon the angular, marginal ridge thus formed. Free margin of the left valve incurved and covering the inflexed margin of the opposite valve, with an external, longitudinal groove near the ventral margin.

Remarks.—This species differs from any of the described species of the genus in its marginal row of tubercles upon the right valve. The specimens studied range from 1 mm. to 3 mm. in length, but scarcely vary in their proportions. The right valve of the species closely resembles, in its form and ornamentation, the left valve of *Aparchites granilabiatus* Ulr.,* but the left valve of this New Jersey species is quite different from that of Ulrich's species. Furthermore, the free margin of the left valve of the species here described overlaps the margin of the right valve, this being a character which would exclude it from the genus *Aparchites.*

EURYCHILINA OCULIFERA n. sp.

Plate XIII., Fig. 16.

Carapace subelliptical; valves moderately convex, with a nearly central, subcircular pit surrounded by a slightly-elevated rim, with a slight prominence obliquely above and to the front of it. Marginal area convex, separated from the body of the valve by a sharply-impressed groove, the free margin extended into a narrow frill. Surface nearly smooth, the marginal border and frill marked by obscure, radiating lines.

The dimensions of a rather large specimen are: length, 2.7 mm.; height, 1.8 mm.; length of hinge-line, 2 mm.

Remarks.—This species may be distinguished from most other members of the genus by its sharply-defined, subcentral pit, which is not connected with the dorsal margin by a sulcus. In this character, howove and in front of the central pit. A slight, moderately-sharp, lique ridge extends from the dorsal margin, near the anterior ex- emity of the hinge-line, forward and downward to above the middle the anterior extremity of the body of the shell. Free margin rdered throughout by a rather broad, concave frill. Surface very nely punctate, the marginal frill marked by more or less obscure, diating lines.

The dimensions of an average specimen are: length, 2.3 mm.; ight, 1.5 mm.; length of hinge-line, 1.7 mm.

Remarks.—This species closely resembles the last one in many of s characteristics, but may always be distinguished from it by reason the absence of the convex marginal area within the marginal frill d by its much wider frill.

DESCRIPTION OF SPECIES FROM THE HUDSON RIVER FORMATION.

The slates and arenaceous beds of the Hudson River formation are most barren of organic remains, and at only three localities have ssils been found. At Sussex there is a thin stratum containing any individuals of but very few species of brachiopods. The other o localities, one near Branchville and the other in the railroad cut Jutland, have afforded only graptolites.

COELENTERATA.

HYDROZOA.

DIPLOGRAPTUS FOLIACEUS (Murch.).

Plate XVI., Fig. 7.

847. *Graptolithus pristis* Hall, Pal. N. Y., vol. I., p. 265, pl. 72, figs. 1 *a–s*.

Description.—Polypary flat, straight, celluliferous on two sides, be- ming gradually broader from the distal extremity for one-half to o-thirds of their length, and then again becoming a little narrower. he maximum width attained is from 2 mm. to 2.5 mm. About fourteen thecæ usually occupy the space of 10 mm.; their free extremit are angular; their inclination to the axis is about 45°.

Remarks.—This is by far the most abundant graptolite at t Branchville locality, being the only one which is at all common.

DIPLOGRAPTUS ANGUSTIFOLIUS (Hall).

Plate XVI., Figs. 8-9.

1859 *Graptolithus angustifolius* Hall, Pal. N. Y., vol. III., p. 51 figs. 1-2.

This species resembles the last, but the polypary is narrower, th thecæ are a little further apart, there being about eleven in the spac of 10 mm., and their outer extremities are rounded.

LASIOGRAPTUS MUCRONATUS (Hall).

Plate XVI., Figs. 16-17.

1847. *Graptolithus mucronatus* Hall, Pal. N. Y., vol. I., p. 268, pl. 73, figs. 1 *a-d*.

This species resembles *Diplograptus foliaceus*, but the outer extremities of the thecæ are produced in mucronate appendages.

mum width, 1.5 mm. to 2 mm.; distal extremity narrow and abrupt, with two short, lateral spines; and an extension of virgula for 2 mm. to 6 mm. Proximal extremity abrupt, showing a prolongation of the virgula, which terminates in a "disk," varying in shape (apparently with age) from narrowly lanceolate to broadly elliptic, 6 mm. to 10 mm. long and 1 mm. to 3 mm. broad. Thecæ thirty to thirty-six in 25 mm.; short, perpendicular, apertural margins concave, the excavation nearly horizontal (slightly inclined distalward), occupying nearly one-third of width of the polypary."—*Gurley.*

Remarks.—This species is very distinct from *C. bicornis* and *C. typicalis,* differing from the former in the absence of the three prominent spines and the disk developed around them, and from the latter by the constantly prolonged virgula. It is also much smaller than either *bicornis* or *typicalis.*

DICRANOGRAPTUS RAMOSUS (Hall).

Plate XVI., Figs. 10–11.

1847. *Graptolithus ramosus* Hall, Pal. N. Y., vol. I., p. 270, pl. 73, figs. 3 *a–h.*

Description.—Polypary flat, linear below, with thecæ on two sides, dividing above into two divergent branches, which bear thecæ on the outer margins only. Thecæ obtusely rounded at their outer extremities, rather distant, slightly narrowed toward the base, about twelve occupying the space of 10 mm.

Remarks.—This species may be easily recognized by its bifurcating polypary, being different in this respect from any of its associates in the New Jersey fauna.

COENOGRAPTUS GRACILIS (Hall).

Plate XVI., Fig. 19.

1859. *Graptolithus gracilis* Hall, Pal. N. Y., vol. III., p. 510, figs. 1–7.

Description.—Polypary consisting of two principal stipes, which diverge from a point of attachment, and in the adult forms a sigmoidal curve. The branches arise from the outer sides of the two principal stipes; they are slender, gradually enlarging and bear thecæ only on one side, the thecæ being rather distant, their length greater than the width of the branch upon which they are borne.

Remarks.—This species is represented in the New Jersey collections only by exceedingly imperfect specimens, which but partially exhibit the details of structure. The accompanying illustration is copied from Hall's.

CORYNOIDES CALICULARIS Nich.

Plate XVI., Figs. 12–13.

1867. *Corynoides calicularis* Nich., Geol. Mag., vol. IV., p. 108, pl. 7, figs. 9–11.

Description.—"The stipe varies in length from one-third to half *caliculuris* Nich. These New Jersey specimens, however, are poorly preserved, and in none of them is the toothed, distal margin well shown. The figures of the species given on plate XVI. are all copied from Nicholson, none of the New Jersey specimens being well enough preserved for illustration.

RETEOGRAPTUS GEINITZIANUS Hall.

Plate XVI., Fig. 18.

1859. *Reteograptus geinitzianus* Hall, Pal. N. Y., vol. III., p. 518, fig.

This imperfectly-understood graptolite possesses a peculiar reticulate skeleton, consisting of three or more rows or series of subquadrangular or hexagonal reticulations, without central axis. No definite thecæ have been observed. In the New Jersey collections it is represented by a single incomplete specimen from Jutland.

VERMES.

ANNELIDA.

CORNULITES sp. undet.

Plate XVI., Fig. 1.

Scattered among the brachiopod shells in the fossiliferous layer of the Hudson River slate at Sussex there are occasional specimens of a small, tubicolor annelid, which is doubtless a member of the genus *Cornulites*. The material is altogether too imperfect, however, for specific identification.

MOLLUSCOIDEA.

BRACHIOPODA.

PLECTAMBONITES SERICEUS (Sow.).

Plate XVI., Figs. 2–3.
See, also, p. 149, pl. IX.

In the flagstone quarry at Sussex a thin, arenaceous layer, charged with calcareous material, is filled with a few species of fossils, by far the most abundant of which is *P. sericeus.* The specimens are all much smaller that the Trenton representatives of the species and many of them are proportionately broader.

PLECTORTHIS PLICATELLA (Hall).

Plate XVI., Fig. 6.
See, also, p. 152, pl. IX.

A single incomplete impression of the pedicle valve of this species has been recognized from Sussex. Scarcely enough of it is preserved to exhibit its characters properly, but it is apparently less

CHAPTER VIII.

FAUNAS OF SILURIAN AGE.

The geologic formations in New Jersey which are here referred the Silurian are the Shawangunk-Green Pond conglomerate, the edina-Longwood sandstone, the Poxino Island shale, the Bossardlle limestone, the Decker Ferry formation, the Rondout formation id the Manlius limestone. Of all these the Shawangunk-Green Pond nglomerate, the Medina-Longwood sandstone, the Poxino Island and e Bossardville formations have not been found to be fossilferous, eir strata being absolutely destitute of organic remains so far as vestigations have been carried. The Decker Ferry formation, on he other hand, is highly fossilferous and contains a most interestng fauna of Silurian age. The fauna is not entirely homogeneous hroughout, as several distinct life zones have been recognized, as lready described in an earlier portion of this report. The fauna, owever, has much in common throughout, and all the species, in hichever zone they may occur, are here described in one faunal roup.

The fauna of the Rondout formation is very different from the ecker Ferry fauna, being constituted almost exclusively of Ostraode crustaceans belonging to the genus *Leperditia,* while in the anlius limestone there is a recurrence of the brachiopods and other rms of life which were present before the Rondout time, associated ith numerous ostracode crustaceans.

DESCRIPTIONS OF SPECIES IN THE DECKER FERRY FAUNA.

COELENTERATA.

ANTHOZOA.

DIPHYPHYLLUM INTEGUMENTUM Barrett.

Plate XVII., Fig. 11.

1878. *Diphyphyllum integumentum* Barrett, Ann. N. Y. Acad. Sci., vol. I., p. 123.

Description.—Corallum simple, subcylindrical, gradually enlarging in size, the external surface marked by vertical, rounded costæ and by more or less irregular transverse wrinkles. In transverse section the outer wall is seen to be thick; the septa are from forty-four to fifty-two in number, about every fourth one of which reaches the centre; within the outer wall is a zone about equal to the thickness of the wall itself, which is apparently free from dissepiments; within this zone, to the centre of the corallite, constituting about two-thirds of the entire diameter, dissepiments are always present in greater or less abundance. In vertical section the open zone, which appears to be free from

PRISMATOPHYLLUM INEQUALIS (Hall).

Plate XVII., Figs. 12–13.

Columnaria inequalis Hall, Pal. N. Y., vol. II., p. 323, pl. 72, figs. 3 *a–b,* 4 *a–c.*

scription.—Corallum growing in irregularly subhemispheric es, composed of prismatic corallites, in contact on all sides, having o eight sides when mature, but often with only three or four d sides when immature. Each corallite has a calyx of moderate ı, and when full grown has thirty-six septa. In cross-section the are seen to be arranged more or less irregularly in four subequal os, and between the septa are curved dissepiments, which, near urface of the corallum, are restricted to a peripheral zone, surling a central, circular portion of about one-third the diameter e corallite. Deeper in the corallum the dissepiments also occupy entral portion of the cross-section, but are thinner and less lant than in the outer zone. In vertical section, when cut directly gh the middle of the corallite, the outer zone is seen to be filled short, curved, vesicular dissepiments; in the central portion lissepiments are much more elongate vertically. In a vertical n, cut a little to one side of the centre, the cross-sections of the , seen in the central vertical area, bear lateral spinules, which about one-half the distance across the interseptal loculæ. These l processes seem to be continuous horizontally across the inner on of the septa.

e masses of this coral frequently attain a diameter of 15 or 20 and range in size from these dimensions to small colonies. The st corallites have a diameter of 10 mm., but this size is excepl, and they range from this to the younger corallites only 1 or 2 in diameter near the initial points.

marks.—This species is evidently a member of the genus *natophyllum* as established by Simpson.* It is one of the comst forms in the coralline bed of the Decker Ferry formation.

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ull. N. Y. St. Mus., No. 39, vol. VIII., p. 218.

FAVOSITES CORRUGATUS n. sp.

Plate XVII., Figs. 1-2.

Description.—Corallum explanate, forming masses 15 to 20 cm. in width by 2 to 2.5 cm. in thickness. Corallites polygonal, usually hexagonal in cross-section, 1 to 1.5 mm. in diameter. Tabulæ numerous, situated at distances of about one-half tube diameter apart. The sides of the corallites are transversely corrugated, the corrugations being strongest near the angles, so that in longitudinal section the sides of the corallites are wavy lines. Walls of the corallites perforated by a single vertical row of mural pores.

Remarks.—This species may be easily recognized by the conspicuous transverse corrugations of the corallite walls, in which respect it differs from any similar form.

FAVOSITES PYRIFORME (Hall).

Plate XVII., Figs. 3-5.

1852. *Astrocerinum pyriforme* Hall, Pal. N. Y., vol. II., p. 123, pl. 34 A. figs. 1 *a–c*.

Description.—Corallum pyriform or obconical in the smaller colonies, the point of attachment small, becoming subhemispherical in the larger colonies. The corallites are exceedingly irregular in size,

ed in the coralline layer at the summit of the Decker Ferry for-
tion. It may be easily distinguished from the last species by its
it of growth and by the absence of the transverse corrugations of
walls. The two species have not been seen together in the same
tum, one being characteristic of the lowest and the other of next
the highest bed in the Decker Ferry formation.

CLADOPORA RECTILINEATA Simpson.

Plate XVII., Figs. 14–17.

9. *Cladopora rectilineata* Simpson, Trans. Am. Phil. Soc., n. ser., vol. XVI., p. 459, fig. 30.

escription.—Corallum consisting of nearly cylindrical, occasion-
branching stems from 2.5 to 3 mm. in diameter. The corallites
arranged in nine vertical series in the cylindrical branches; they
simple tubes radiating obliquely from the axis and gradually
arging towards the aperture, with neither septa nor tabulæ. The
rtures are wider than high, the lower side being margined by a
htly-projecting lip. The apertures in adjacent vertical series are
egularly alternating in position.

Remarks.—In none of the New Jersey material is the form of the
nplete corallum of this species shown, all the specimens observed
ng but broken branches, which are rarely observed to be more
n 25 mm. in length. There may be some variation in the number
vertical series in which the corallites are arranged, but in all the
ecimens in which their number could be definitely counted it was
nd to be nine. The species most closely resembles *C. seriata* Hall,
t in that species the apertures of the corallites are more closely
wded together laterally, and are more regularly alternating in
ition, so that their arrangement is apparently in spiral lines rather
n in the straight, vertical lines of *C. rectilineata*.

HALYSITES CATENULARIA (Linn.).

Plate XVII., Figs. 6–8.

1767. *Tubipora catenularia* Linn., Syst. Nat., 12th edit., p. 1270.
1851. *Halysites catenularia* E. & H., Monog. des. Polyp. Foss., p. 281.
1852. *Catenipora escharoides* Hall, Pal. N. Y., vol. II., p. 127, pl. 35, figs. 1 *a–c*.
1876. *Halysites catenulata* Rominger, Geol. Surv. Mich., vol. III., pt. II., p. 78, pl. 29, figs. 1, 2, 4.
1899. *Halysites catenularia* Lambe, Cont. Canadian Pal., vol. IV., pt. I., p. 68, pl. 3, figs. 1–1 *b*, 2–2 *b*.

Description.—Corallum forming large masses, 10 to 40 cm. in diameter, made up of elongate, upright, subelliptical corallites, joined together by their edges in chain-like series, so as to form vertical, anastomosing laminæ, inclosing interspaces of variable form and size. Between each pair of corallites is a small, vertical tubule, which is parallel with and of the same length as the corallites. In transverse section the corallites are about 2 mm. wide and 2.5 mm. long, subcircular or subelliptical in outline, with twelve septal spines. The tubules are quadrangular in outline, with their longer diameter transverse to the vertical lamina of corallites, and crossing the interspace may usually be detected one or more sections of the highly-convex tabulæ. In vertical section the corallites are crossed by numerous

ZAPHRENTIS sp. undet.

Plate XVII., Figs. 9–10.

:ous specimens of horn coral, usually imperfectly preserved, ›nt in the fauna of the coralline bed at the summit of the ?erry formation. Several species are probably present, but too imperfectly represented for satisfactory study. Other s representing the same genus are more rarely present in the 'ata of the formation.

HYDROZOA.

STROMATOPORA CONCENTRICA Goldf.

s of a stromatoporoid hydrozoon are not uncommon in the layer at the summit of the Decker Ferry formation, which provisionally referred to *Stromatopora concentrica.* In none pecimens examined in thin section were the characters suffi- ell preserved for accurate identification.

MOLLUSCOIDEA.

BRYOZOA.

MONOTRYPA CORRUGATA n. sp.

Plate XVIII., Figs. 1–5.

iption.—Zoarium forming lenticular or hemispheric masses. hemispheric specimen has a diameter of 40 mm., with a height m., the base being concavely excavated to a depth of 7 mm. ecimens are frequently much flatter, sometimes with a height ore than 5 mm. The celluliferous surface of the zoarium is so closely covered with matrix that the zoœcial apertures are ibited. In longitudinal fractures the zoœcial walls separate along their median lines, and the walls themselves are seen to be transversely corrugated. In cross-section the zoœcia are polygonal in outline, about ten of average size occupying the space of 3.5 mm. Interspersed with the average-sized zoœcia are smaller ones which are younger, but no true mesopores are present. In longitudinal section the walls of the zoœcia are wavy. Diaphrams are absent from the lower portion of the tubes, but are present distally, becoming more and more frequent toward the exterior, the outermost ones being about one tube diameter apart.

Remarks.—This species most closely resembles *Chætetes* (*Ptychonema*) *tabulatus* H. & S., since referred to the genus *Monotrypa* by Nickles and Bassler, which is said to be derived "probably from the Upper Helderberg group, Schoharie, N. Y.," so that its geologic horizon is somewhat uncertain. The transverse zoœcial corrugations of *M. tabulatus* are more conspicuous than in the New Jersey species, and the diaphrams are apparently entirely absent.

PTILODICTYA FRONDOSA n. sp.

Plate XIX., Figs. 1–4.

Description.—Zoarium bifoliate, frondescent in form, often more or less undulate; beginning with a narrowly-rounded or obtusely-pointed base of attachment or articulation, from which point it broadens rapidly, the distal end more or less bluntly rounded; the axial line is curved gently near the base, becoming nearly straight beyond the first third of its length. The mesotheca, along which specimens almost mm., with a width of 30 mm., but usually they are relatively somewhat narrower. About four zoœcia occupy the space of 1 mm. longitudinally and about four and one-half transversely.

Remarks.—This species resembles *P. expansa* Hall, but is curved and does not have the perfectly parallel margins of that species; it also lacks the axial rows of zoœcia, which are conspicuously narrower than those on the sides. In form the zoarium is almost identical with *Phænopora platyphylla* Jas., but thin sections show the two forms to be generically distinct. The species is apparently most closely allied to that called *Ptilodictya lanceolata* var. *americana* by Fœrste, but it does not have the sharply differentiated medial rows of smaller zoœcia which seem to be indicated in the illustrations of that species, and the basal portion of the zoarium is more curved. In none of the New Jersey specimens has the cell-bearing surface been seen clear of the matrix, so that it is not possible to state with certainty whether or not monticules are present, but they seem to be absent.

ESCHAROPORA SILURIANA n. sp.

Plate XVIII., Figs. 6–7. Plate XIX., Figs. 8–9.

Description.—Zoarium thin, bifoliate, complete outline unknown. The mesothecal surface, along which the specimens uniformly separate, is uneven, with numerous, more or less irregular, curved, transverse wrinkles. In tangential section the zoœcia are more or less irregularly hexagonal in outline, the openings being subelliptical. The prostrate portions of the zoœcia are elongate and are initially arranged in longitudinal series, but when they become erect adjacent series are crowded together, giving to the apertures an irregularly decussate arrangement. In vertical section the zoœcia are thick walled above and in their erect portions usually about four slightly-convex diaphragms are present. The two hemisepta have been clearly seen in but one zoœcium, though it is possible that they may usually be present.

Remarks.—This genus has not before been recorded from strata younger than the Ordovician. These specimens, however, agree essentially in all generic characters with the Ordovician forms, but the zoaria are apparently larger and more irregular in form than is usually the case in the older species.

BRACHIOPODA.

PHOLIDOPS OVATA Hall.

Plate XX., Figs. 27–29.

1859. *Pholidops ovatus* Hall, Pal. N. Y., vol. III., p. 490, pl. 103 *B*, figs. 7 *a–b*.

Description.—Shell small, ovate to subelliptical in outline, slightly narrower in front, apex excentric posteriorly. Surface marked by fine, sublamellose, concentric lines. Internally the anterior adductor muscle impressions are situated at about the midlength of the shell; each impression is elongate-subelliptical in outline, their anterior extremities not in contact and their long axes at nearly right angles to each other. The posterior adductor muscle impressions much smaller, circular in outline, and situated just beyond the posterior extremities of the anterior impressions.

The dimensions of one of the largest specimens observed are: length: 2.7 mm.; width, 2.25 mm.

STROPHEODONTA BIPARTITA (Hall).

Plate XX., Figs. 1–5.

1897. *Stropheodonta nearpassi* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 425.

1897. *Stropheodonta textilis* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 427.

1897. *Strophomena* (?) *bipartita* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 429.

Description.—Shell with thin, nearly-flat brachial valve and slightly-convex pedicle valve, longitudinally subsemi-elliptical in outline, the hinge-line produced beyond the body of the shell into mucronate extensions, hinge-line crenulate. Surface of both valves marked by fine, irregularly alternating, angular, raised striæ, which are not continuous over the umbo to the beak, and which curve outward on the sides of the shell in passing to the margin, the curvature becoming stronger on approaching the hinge-line. The surface is also marked by much finer, crowded, concentric lines, which continue to the beak. Oblique wrinkles along the cardinal margin are present in many specimens. The interior of the valves, more especially the pedicle, is covered with fine, closely-crowded papillæ, which gives to the surface of internal casts a finely-pitted or punctate appearance. These internal papillæ may frequently be detected through the thin shell substance as dark spots, giving it a punctate appearance, but there are apparently no perforations. The muscular impressions of the pedicle valve are rather large and divergent and are free from impressions of papillæ. In the interior of the brachial valve a low median ridge reaches more than half way to the front of the shell.

The dimensions of a medium-sized specimen are: length, 28 mm., and breadth, 30 mm.

Remarks.—This species is a variable form, and undoubtedly includes the three shells described by Hall under the names *Leptæna* ——— sp., *Leptæna bipartita* and *Strophodonta textilis,* all from the Coralline limestone at Schoharie, New York. The name *Strophodonta nearpassi* was applied by Barrett to specimens from New Jersey from the locality where most of our material was secured. If the generic or subgeneric name *Leptostrophia,* given by Hall and Clarke to the very flat forms of Stropheodontas, is to be retained, the present species will be there included.

The finer surface characters of the shell are rarely preserved upon the specimens studied, but different individuals, or even different portions of the same individual, under various conditions of exfoliation, exhibit all the types of fine surface markings figured by Hall for his three species. These markings, as seen upon a well-preserved shell surface, are most nearly correctly illustrated under his *S. textilis*. Toward the beak the radiating markings are absent, and young shells preserving only this portion of the shell present the aspects of species of *Pholidostrophia*. The mucronate extensions of the hinge-line are but rarely preserved, but the direction of the fine, concentric markings near the hinge-line indicate their presence on most individuals. Perhaps the most characteristic feature of the species is the strongly papillose interior of the valves, which is best shown only on exfoliated specimens.

LEPTAENA RHOMBOIDALIS (Wilck.).

Plate XX., Fig. 10.

For complete biography see Schuchert, Bull. U. S., Geol. Surv., No. 87, p. 240.

Description.—Shell concavo-convex, flattened posteriorly, geniculate towards the lateral and front margins, hinge-line straight, usually

ORTHOTHETES INTERSTRIATUS (Hall).

Plate XX., Figs. 8–9.

1852. *Orthis interstriata* Hall, Pal. N. Y., vol. II., p. 326, pl. 74, figs. 1 *a–b*, 2 *a–b*.

1897. *Orthothetes interstriatus* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 297.

Description.—Shell small, subplano-convex, wider than long, the hinge-line straight, about equal to the greatest width of the shell. The lateral margins meet the cardinal line at nearly right angles and are then regularly rounded to the front of the shell. Pedicle valve obscurely subcarinate, its greatest depth near the prominent, suberect beak; cardinal area rather high, nearly flat. Brachial valve depressed convex or nearly flat, with a broad, shallow, ill-defined mesial sinus. Surface of both valves covered with rather coarse, angular, radiating costæ, which increase by implanation toward the margin, and by rather coarse, concentric lines of growth.

The dimensions of a pedicle valve are: length, 5.5 mm.; width, [illegible] mm.; convexity, 1.5 mm. A brachial valve measures: length, 4.5 mm.; width, 6 mm.

Remarks.—All of the specimens of this species which have come under observation are more or less exfoilated, so that the concentric markings are usually wholly obliterated. On a few specimens, however, they may be detected.

ORTHOTHETES DECKERENSIS n. sp.

Plate XX., Figs. 6–7.

Description.—Shell subplano-convex, transversely subelliptical in outline, the hinge-line shorter than the greatest width of the shell. which is near the middle. Pedicle valve depressed, the umbonal region usually irregularly concave; the concave area, having been a facet of attachment to some external object, retains the reverse of the contour of the object to which the shell was attached. Between the umbonal concavity and the margin this valve is marked by one or more conspicuous, more or less irregular, concentric wrinkles, with less conspicuous intermediate ones. The cardinal area is unsymmetrical and variable because of the attachment of the shell, but it is always rather low; its margin is sometimes sharply defined, but is often very poorly defined. The brachial valve is more or less regularly convex, the greatest convexity usually being posterior to the middle; it is never so strongly marked by concentric wrinkles as the opposite valve. Both valves are marked by fine, more or less unequal, radiating ribs, of which three or four occupy a space of one millimeter at the margin of the shell. The larger ribs extend the entire length of the shell, while the smaller ones are intercalated at various distances from the beak.

The dimensions of a rather large pedicle valve are: length, 20.5 mm.; width, 25.5 mm.; height of area at centre, 3 mm.; maximum depth of valve, 4.5 mm. A brachial valve having the same length and breadth has a convexity of 9 mm.

Remarks.—This species differs greatly from any other Silurian species of the genus, having a much closer resemblance to younger forms such as *O. chemungensis* of the Devonian and some Carboniferous species. It differs from any of these younger forms, however, in its much larger facet of attachment upon the umbo of the pedicle valve.

CHONETES JERSEYENSIS Weller.

Plate XX., Figs. 11–16.

ght anterior curvature as they approach the margin. As the ells increase in size this peculiar curvature of the ribs becomes re and more conspicuous, and can always be detected to a greater less degree in the adult individuals, and it is always more conicuous in the brachial than in the pedicle valve. Just anterior the beak in both valves there is a small area where the radiating s are obsolete. In addition to the radiating ribs, both valves are rked by exceedingly fine, concentric lines.

The dimensions of a large individual are: length, 14 mm., and dth, 22 mm.

Remarks.—This species is exceedingly abundant in the lower beds the Decker Ferry formation. It may be always recognized, in the ger specimens at least, by the peculiar curvature of the radiating s. Among the smaller, and therefore younger, specimens, however, is character is a variable one, the curvature of the ribs seeming to rt earlier in the life history of some individuals than in others. comparing young individuals of approximately the same size one ll frequently be seen to possess perfectly-straight ribs, while in the ier the ribs will be slightly curved. In the large specimens, however, the curvature may always be detected. On comparing smaller cimens with straight ribs and larger ones with curved ribs the difences seem to be sufficient to indicate distinct species, but as all rmediate characters seem to exist, they are all placed together in same species.

ORTHIS FLABELLITES Foerste.

Plate XX., Fig. 20.

7. *Orthis flabellites* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 286. (A full bibliography of this species will be found here.)

Description.—Brachial valve subelliptical in outline, depressed conc, hinge-line equal to or a little shorter than the greatest breadth the shell; median portion flattened or slightly concave, forming broad, shallow, median sinus, whose centre is scarcely depressed low its sides. Surface marked by from thirty to thirty-six strong, diating ribs, between which, near the margin in internal casts, there re intercalated some finer ribs. Pedicle valve not recognized in the lew Jersey collections.

The dimensions of the best specimen observed are: length, 17 mm.; width, 22 mm.

Remarks.—The only specimens of this shell which have come under observation are more or less imperfect casts of the interior, and only brachial valves have been seen. These cannot be certainly identified with *O. flabellites* Foerste, but they are closely allied to that species, and it is probable that they should be included in it.

DALMANELLA POSTELEGANTULA n. sp.

Plate XX., Figs. 21-24.

Description.—Shell subcircular in outline, usually wider than long, the hinge-line shorter than the greatest breadth. Pedicle valve strongly convex, subcarinate, the beak incurved over the cardinal area. Brachial valve depressed convex with a shallow, rounded mesial sinus which does not reach to the beak. Surface of both valves marked with fine radiating striæ, from seven to nine of which occupy the space of 2 mm. at the shell margin.

The dimensions of an average specimen are: length, 10.5 mm.; width, 12 mm.

Remarks.—This species is intermediate in its characters between the Silurian *D. elegantula* and Helderbergian *D. subcarinata,* and flabellate, muscular impression, divided along its median line by a prominent median ridge, which reaches more than half way to the front of the shell. Surface marked by fine, radiating striæ, of which about five occupy the space of two millemeters at the shell margin.

The dimensions of an average specimen are: length, 11.5 mm.; width, 13 mm.

Remarks.—This little shell is in all respects a diminutive form of the Helderbegian *R. oblata* H. In size it is similar to the Niagaran *R. hybrida* Sow., but differs from that species in usually being wider than long, instead of longer than wide. It also has a much larger muscular impression in the pedicle valve than *R. hybrida,* in this respect resembling *R. oblata.* The prominent median ridge in the pedicle valve is also a character of *R. oblata.* The shell is in some respects intermediate between these two species, but approaches closest to the Helderbergian *R. oblata.*

PENTAMERUS CIRCULARIS n. sp.

Plate XX., Figs. 17–19.

Description.—Pedicle valve subcircular in outline, gibbous, the beak blunt, slightly incurved, cardinal area absent, delthyrium broadly triangular. Surface smooth, without mesial sinus, marked only by inconspicuous lines of growth. Internally the valve has a strong median septum. The brachial valve is known only from fragments; it resembles the pedicle valve, but is less convex and lacks the prominent beak.

The dimensions of the best-preserved specimen, a pedicle valve, are: length, 16 mm.; width, 16.5 mm.; convexity, 7.5 mm.

Remarks.—The material representing this species is not as perfectly preserved as might be desired, but it seems to constitute an undescribed species. It most closely resembles *P. ovalis,* as identified by Foerste,* from Tennessee and Alabama, but is unlike the original *P. ovalis* of Hall, which is, perhaps, only a diminutive *P. oblongus.*

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* Proc. Bost. Soc. Nat. Hist., vol. XXIV., p. 324, pl. 5, figs. 17–18, and Geol. Surv. Ohio, vol. VII., pl. 30, figs. 17–18.

RHYNCHONELLA DECKERENSIS n. sp.

Plate XXI., Figs. 1–4.

Description.—Shell subtriangular, wider than long, the postero-lateral margins sloping from the beak, where they form an angle of from 95° to 115°, in nearly straight lines to a point a little posterior to the middle of the shell; the lateral and front margins regularly rounded. The pedicle valve is usually a little less convex than the opposite one; its beak is prominent, arched, but not strongly incurved; the sinus is rather abrupt, not reaching quite to the beak. The suface of the brachial valve curves gently to the margins, except toward the front, where the mesial fold is rather abruptly elevated. The surface of each valve is marked by from twenty to twenty-four simple, angular plications, of which two or three, somewhat coarser than the remainder, are depressed in the median sinus, with a corresponding number elevated in the fold of the brachial valve.

The dimensions of a rather large specimen are: length, 15 mm.; width, 19.5 mm.; thickness, 10 mm.

Remarks.—This shell is a rather common one in the lower beds of the Decker Ferry formation. It resembles *Rhynchotrema formosum* Hall, from the higher portion of the Helderbergian series, but may be distinguished from that species by its coarser plications, its greater ck of the centre of the valve. Brachial valve most prominent at id in front of the middle; mesial fold not conspicuous, except near e front margin. Each valve marked by from eighteen to twenty-two mple, angular plications, three of which are usually included in e sinus of the pedicle valve. The finer markings of the shell, if ey were present, have been obliterated by exfoliation.

The dimensions of an average adult specimen are: length, 9 mm.; dth, 9.5 mm., and thickness, 5.5 mm.

Remarks.—This little shell is one of the most abundant species in e Decker Ferry formation, being present in each of the faunal zones. is especially abundant in the lower beds. The species resembles ***transversa*** of the Helderbergian fauna, and may be ancestral to it, it the mesial fold of the brachial valve is never so much elevated front as in the adult individuals of that species. The species also sembles *Camarotœchia neglecta* Hall, as illustrated in volume II. the New York Paleontology, from the Clinton and Niagaran faunas, it it does not at all resemble the shell from the Niagaran fauna at aldron, Indiana, to which that name is applied.

WILSONIA GLOBOSA n. sp.

Plate XXI., Figs. 12-22.

escription.—Shell subglobose, a little longer than wide. Pedicle e less convex than the brachial, its beak suberect or slightly arched, ly pointed, umbo smooth and convex, mesial sinus shallow, be- ng near the middle of the valve and produced as a lingual ex- n in front, at nearly a right angle to the plane of the valve. ial valve strongly convex or gibbous, smooth posteriorly, anterior deeply sinuate, mesial fold slightly elevated, originating near ddle of the valve. The surface of each valve is marked by or eighteen simple, low, rounded plications, sometimes slightly anteriorly and becoming nearly or quite obsolete posteriorly, that portion of both valves smooth. From two to five plica- e included within the sinus, the more common number being th a corresponding number in the fold of the opposite valve. imensions of a rather large globose individual are: length, width, 11 mm.; thickness, 10 mm. Those of another less pecimen are: length, 11.25 mm.; width, 10.5; thickness, *Remarks.*—In some of its characters this species resembles the Helderbergian forms *Uncinulus mutabilis* H. and *U. nucleolata* H. It differs from both of them, however, in its smaller size, and in the obsolescence of its plications on the posterior portions of the shell. Internally there are conspicuous differences which are of even generic value. In *Wilsonia globosa* the cardinal process is absent, the hinge-plate is divided and is supported by a strong median septum. These characters, when associated with its external form, place it in the genus *Wilsonia,* while the two Helderbergian species mentioned possess well-developed cardinal processes and the other characters which distinguish the genus *Uncinulus.*

ATRYPA RETICULARIS (Linn.).

Plate XXI., Figs. 35–37.

1897. *Atrypa recticularis* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 154. A complete bibliography of this species may be found in this place.

Description.—Shell subcircular or subelliptical in outline and subhemispherical in general form, hinge-line shorter than the greatest breadth. Pedicle valve nearly flat, slightly convex on the umbo but concave toward the margins, beak small. Brachial valve strongly convex or gibbous, the greatest elevation near the centre, from which point it curves down regularly to the margins on all sides, the beak brachial valve. Most of the Helderbergian representatives of the species are the more finely-marked forms, but in the Silurian faunas both coarsely and finely-marked varieties occur.

ATRYPA? LAMELLATA Hall.

Plate XXI., Figs. 23–29.

1852. *Atrypa lamellata* Hall, Pal. N. Y., vol. II., p. 329, pl. 74, fig. 11.

1897. *Rhynchonella? lamellata* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 359.

Description.—Shell small, subrhomboidal in outline, the valves subequally convex. Pedicle valve with an acutely-pointed, incurved beak; the sharply-defined mesial sinus deep in front and flattened in the bottom, not continuous to the beak. Brachial valve with an elevated fold in front, the lateral slopes regularly convex. Surface of each valve marked by from ten to fourteen simple, rounded or subangular, radiating plications, one, two or three, but usually two, of which are within the mesial sinus of the pedicle valve, with a corresponding number on the fold of the opposite valve. The radiating plications are crossed by strong, imbricating, concentric lamellæ, which give to the whole surface of the shell a rugose appearance.

The dimensions of a large specimen are: length, 7 mm.; width, 7.25 mm.; thickness, 5 mm. Another specimen measures: length, 5.66 mm.; width, 7 mm.; thickness, 4 mm.

Remarks.—Most specimens of this species are smaller than those whose dimensions have been given. The shell has a strong resemblance to those members of the genus *Atrypa* which are allied to *A. marginalis* Dal.—in fact, this species resembles in many respects a diminutive *A. marginalis*. In order to determine whether or not a brachidium of the type of that in the genus *Atrypa* is present in this species, numerous specimens have been ground down, but in no case have the spires been observed, but a pair of long, slender crura have been detected. The generic reference of the species, therefore, remains in doubt, and it is quite possible that it should be placed with the Rhynchonelloids, as has been done by Schuchert.

SPIRIFER VANUXEMI Hall, var. MINOR n. var.

Plate XXI., Figs. 41–42.

1859. *Spirifer vanuxemi* Hall, Pal. N. Y., vol. III., p. 198, pl. 8, figs. 17–23.

Description.—Shell small, subelliptical in outline, the hinge-line a little shorter than the greatest width of the shell. Umbo of pedicle valve prominent, beak incurved over the moderately high, concave, ill-defined cardinal area; mesial sinus rather broad, rounded in the bottom, the lateral slopes marked by three broadly-rounded plications on either side. Brachial valve depressed-convex, with a rounded median fold, which is but slightly elevated above the plications on either side. Surface of both valves marked by concentric lines of growth.

The dimensions of the largest specimen of the pedicle valve are: width, 7 mm.; length, 5.5 mm., and convexity, 3 mm.

Remarks.—This little shell is not abundant in the Decker Ferry fauna. It seems to agree closely with *Spirifer vanuxemi* Hall, of the Manlius limestone fauna, except in being smaller and in having the concentric markings less conspicuous.

CYRTINA MAGNAPLICATA n. sp.

Plate XXI., Figs. 46–49.

The best-preserved brachial valve is somewhat smaller: breadth, 14 mm., and length, 8 mm.

Remarks.—Although the punctate shell structure has not been detected in any of the specimens of this species which have come under observation, it has all the outward characters as well as the strong median septum in the pedicle valve, of the genus *Cyrtina,* and there seems to be no doubt as to its correct generic reference here. This species differs from the only other American Silurian species of the genus, *C. pyramidata* H., in its larger size and in its concave and less sharply-defined cardinal area. From any of the Devonian members of the genus it may be distinguished by its coarser plications and by its less sharply-defined cardinal area.

RETICULARIA BICOSTATA (Vanuxem).

Plate XXI., Figs. 44–45.

1842. *Orthis bicostatus* Van., Geol. N. Y., Rep. 3d Dist., pp. 91, 94.
1852. *Spirifer bicostatus* Hall, Pal. N. Y., vol. II., p. 263, pl. 54, fig. 4.
1893. *Spirifer bicostatus* H. & C., Pal. N. Y., vol. VIII., pt. II., pl. 36, fig. 7.
1897. *Reticularia bicostata* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 341.

Description.—Shell transversely subelliptical, the hinge-line less than the greatest breadth. Pedicle valve strongly convex, beak prominent and incurved, cardinal area arched, not sharply defined, mesial sinus shallow, without plications. On each lateral slope of the valve are three or sometimes four, low, rounded, inconspicuous plications, which do not reach to the beak; the largest one of these bounds the mesial sinus, while the others successively grow smaller. Brachial valve less convex than the opposite one, with a low, rather sharply-defined mesial fold, and with indistinct plications on the sides of the valve corresponding with those of the pedicle valve. The surface of both valves marked by moderately fine, concentric, lamellose lines.

The dimensions of a large pedicle valve are: length, 13 mm.; width, 16 mm.; convexity, 6 mm.

Remarks.—The pedicle valve of this abundant species of the lower Decker Ferry beds is most commonly preserved, brachial valves being comparatively uncommon. The species may usually be recognized by its inconspicuous plications, though in some individuals, particularly the younger ones, they are wholly obsolete. Most of the specimens are exfoliated so that the fine, concentric markings of the surface are usually obliterated, but they may be detected upon occasional specimens.

RHYNCHOSPIRA FORMOSA Hall.

Plate XXI., Figs. 30–34.

1859. *Trematospira formosa* Hall, Pal. N. Y., vol. II., p. 215, pl. 36, figs. 2 *a–t*.

1859. *Rhynchospira formosa* Hall, Pal. N. Y., vol. II., p. 485, pl. 95 *A*, figs. 7–11.

1893. *Rhynchospira formosa* H. & C., Pal. N. Y., vol. VIII., pt. II., p. 109, pl. 50, figs. 21–25.

Description.—Shell ovoid in outline, usually a little longer than wide, valves subequally convex, rostrate posteriorly, rounded in front, usually with a slight emargination in the middle. Pedicle the Helderbergian specimens, the more coarsely plicated individuals from the higher beds being similar to the Decker Ferry specimens. These specimens seem also not to grow as large as those in the Helderbergian fauna.

WHITFIELDELLA NUCLEOLATA (Hall).

Plate XXI., Figs. 38–40.

1852. *Atrypa nucleolata* Hall, Pal. N. Y., vol. II., p. 328, pl. 74, figs. 10 *a–m*.

1897. *Whitfieldella* (?) *nucleolata* Schuchert, Bull. U. S. Geol. Surv., No. 87, p. 461.

Description.—Shell subglobose, small, subovate in outline, a little longer than wide, rostrate posteriorly, slightly flattened or emarginate in front. Pedicle valve with a prominent, incurved beak, slightly flattened or sinuate along the median line. Brachial valve slightly less convex than the pedicle, most prominent posterior to the middle, usually flattened or slightly sinuate along the median line towards the margin. Surface of both valves smooth or marked only by inconspicuous, concentric lines of growth.

The dimensions of an average specimen are: length, 7 mm.; width, 6.5 mm.; thickness, 5 mm.

MOLLUSCA.

PELECYPODA.

EDMONDIA? DECKERENSIS n. sp.

Plate XXII., Figs. 6–7.

Description.—Shell subovate in outline, height about three-fourths the length; the beak rather small, situated about one-fifth the length of the shell from the anterior end; hinge-line arcuate. Anterior margin rather sharply rounded, the ventral and posterior margins broadly rounded; the curve from the centre of the ventral margin to the posterior extremity of the hinge-line being nearly a semi-circle. The valves are rather strongly convex, the greatest depth being near the centre.

The dimensions of the type specimen, a right valve, are: length, 24 mm.; height, 18 mm.; convexity, 5 mm.

Remarks.—The hinge characters of this shell are not preserved, so that its generic reference is somewhat uncertain. The surface characters are also obliterated, but the shell is believed to be nearly smooth or to be marked only by lines of growth.

NUCULA? sp. undet.

Plate XXII., Fig. 5.

Description.—Shell small, subovate in outline, obliquely truncated posteriorly, regularly convex. The beak is prominent, situated a little in front of the middle of the shell. Surface marked by fine, concentric lines of growth.

The dimensions of the most perfect valve are: length, 14.5 mm.; height, 10 mm., and convexity, 3.5 mm.

Remarks.—The hinge characters of this species have not been observed, but the shell itself has the general form and appearance of many Nuculoid shells, so that it is referred provisionally to the genus *Nucula*.

line. Whole surface of the valve covered with narrow, angular, raised striæ, with interspaces two or three times the width of the ridges, and by similar concentric striæ. Right valve not seen.

The dimensions of a nearly-perfect left valve are: length, 10.5 mm., and height, 9.5 mm.

Remarks.—This little shell is rare in the Decker Ferry fauna, but it seems to agree in all essential characters with *P. emacerata* Con. of the Niagaran fauna. The typical representatives of the species occur in the Rochester shale of Western New York and are larger than the New Jersey shell. Because of their mode of preservation, they are also usually crushed so as to appear less convex. In form, proportions and markings, however, the shells from the two localities are essentially identical.

PTERINEA? sp. undet.

Description.—A single imperfect specimen of an oblique, winged shell, marked by alternately larger and smaller, radiating ribs, is, perhaps, a member of the genus *Pterinea*. So far as can be judged, its dimensions are: length, about 20 mm., and height, about 18 mm.

PTERONITES? SUBPLANA (Hall).

Plate XXII., Fig. 1.

1852. *Avicula subplana* Hall, Pal. N. Y., vol. II., p. 283, pl. 59, fig. 3 *a–c*.

Description. — Left valve depressed-convex, winged posteriorly, subovate in outline, apart from the posterior extension of the hinge-line; beak nearly terminal, hinge-line equaling the greatest length of the shell. From the anterior extremity of the hinge-line the margin curves regularly to the postero-ventral angle, the curvature becoming more gentle posteriorly; it then curves rather abruptly into the posterior margin, which is sinuate and meets the posterior extremity of the hinge-line at an acute angle. The entire surface of the shell is marked by rather fine, somewhat irregular, concentric lines of growth, with no indications of radiate markings.

The dimensions of the largest and best specimen observed are: length, 45 mm., and height, 28 mm.

Remarks.—Hall's original figures of *Avicula subplana* allow a great deal of variation in the outline of the species. The several Decker Ferry specimens referred here also exhibit considerable variation, but none of them correspond exactly with either of Hall's figures, the posterior margin being more sinuate, with the posterior extremity of the hinge-line more acute. The species is here referred to the genus *Pteronites*, as it seems to be more nearly in accord with members of that genus than with any other Paleozoic genus, although in no specimens have the hinge characters been preserved, nor has the right valve been seen. Heretofore the members of this genus have not been recorded earlier than the Chemung fauna of the Devonian, and all of the described species are from the Chemung and the lower Carboniferous faunas.

PTYCHOPTERIA? SUBQUADRATA n. sp.

Plate XXII., Fig. 2.

Description.—Right valve unknown. Left valve subquadrangular in outline, depressed-convex, with anterior and posterior wings; hinge-line a little shorter than the total length of the shell, the beak projecting slightly beyond the hinge-line and situated about one-third the length of the shell from the anterior margin. The anterior [redacted] forms nearly a right angle with the hinge-line; below it rounds [redacted] ventral margin; posteriorly the ventral [redacted] rather abrupt turn; the [redacted] obtuse

ACTINOPTERIA RETICULATA n. sp.

Plate XXII., Fig. 3.

Description.—Left valve large, subrhomboidal in outline; the body subovate, with an obliquity of 27° between the hinge-line and the umbonal ridge; beak but slightly elevated above the hinge-line. Anterior margin nearly straight or slightly sinuate, forming a rounded angle of about 80° with the hinge-line; basal margin regularly curved; posteriorly it rounds more abruptly into the nearly straight or slightly sinuate posterior margin, which is nearly parallel with the anterior margin. Posterior wing large, slightly convex, limited below by a moderately distinct, rounded sinus; the posterior cardinal extremity obtuse. The body of the shell is marked by conspicuous, concentric lines of growth and by more or less discontinuous, radiating costæ. Near the margin of the shell the concentric lines are more crowded and the radiating costæ are less conspicuous, but on the upper portion of the shell the two sets of markings give to the surface a nodose appearance. The posterior wing is marked like the body of the shell, but the radiating markings are much less conspicuous. Right valve unknown.

The dimensions of the type specimen are: height, 35 mm.; oblique length from beak to postero-basal extremity, 48 mm.; length of hinge-line, 29 mm.

Remarks.—Nothing but the general outline and surface markings of this shell are preserved, but in these characters it seems to resemble more closely the species of *Actinopteria* than any other generic group, and it is consequently placed in this genus, although no members of it have before been recognized earlier than the middle Devonian faunas. Additional material, more perfectly preserved, may serve to change its generic reference.

MYTILARCA OBLIQUA n. sp.

Plate XXII., Fig. 8.

Description.—This species has been observed only in the form of somewhat indefinite casts, in which the hinge characters are not preserved. The general form of the shell resembles *M. arctirostra* H. and

M. mytiliformis Foerste, and it is therefore considered as cogeneric with them. The prominent beak is terminal, and from it an angular umbonal ridge, becoming rounded posteriorly, extends obliquely to the postero-ventral angle of the shell. From the umbonal ridge to the dorsal and posterior margins the surface of the shell is convex; antero-ventrally the slope is abrupt and nearly vertical to the margin.

The dimensions of the type specimen are: extreme length from the beak to the postero-ventral angle, 34 mm.; greatest width at right angles to the above line, 20 mm.; greatest convexity, 10 mm.

Remarks.—This species resembles *M. mytiliformis* Foerste more closely than any other member of the genus, but the shell is more oblique, with a more obtuse beak and with a much more abrupt slope from the umbonal ridge to the antero-ventral margin.

GONIOPHORA sp. undet.

Description.—All the specimens of this species which have been observed are imperfect, so that its characters cannot be determined with certainty. It is a sharply-carinate, oblique shell, with an incurved beak. Dorsally from the carina the shell surface is convex and ventrally it is concave. In no specimen is the outline of the shell complete, but the depth of each valve is apparently greater than the height of the shell. The length of the best-preserved valve, alwhich are plane above, with a broad umbilicus below, in which all of the volutions are probably visible. In cross-section the volutions are subcircular.

LOXONEMA? sp. undet.

Plate XXII., Figs. 9–11.

One or more species of coiled shells, with elevated spires, are present in the lower beds of the Decker Ferry formation. These are all imperfect casts, and preserve no characters by which they may be referred to their proper genera. They may be placed provisionally in *Loxonema*.

PLATYCERAS sp. undet.

Plate XXII., Figs. 12–13.

Description.—Several specimens of what appears to be a small species of *Platyceras* or *Platyostoma* have been observed in the lower beds of the Decker Fery formation. As nearly as can be determined they have about two contiguous volutions, the inner one being very small and the outer one expanding rapidly to the aperture, which is relatively large. In cross-section the volutions are suboval or subelliptical in outline. The upper surface of the volutions lies in a plane.

The dimensions of the most perfect specimen are: diameter, 11 mm.; height of aperture, 8.5 mm.

Remarks.—All the specimens of this little shell which have been observed are imperfectly preserved. One which resembles the remainder in other respects has a sharply carinate periphery, and consequently the cross-section of the volutions is subtriangular. It is not possible to determine from the specimen whether this variation is normal or whether it is produced by a distortion of the shell.

ARTHROPODA.

TRILOBITA.

PROETUS PACHYDERMATUS Barrett.

Plate XXII., Figs. 16–21.

1878. *Proetus pachydermatus* Barrett, Am. Jour. Sci., 3d ser, vol. XV., p. 371.

Description.—Head semi-circular in outline, with a broad, flattened marginal border, the genal angles produced into sharp spines. Glabella subtriangular, with a pair of small, disconnected, ovoid basal lobes; obtusely pointed in front, bordered by a sharply-defined dorsal furrow; the first and second pairs of lateral furrows are rather faint, slightly curved and directed obliquely backward from the margin of the glabella; the third pair more prominent, curved, directed backward and connecting with the occipital furrow by a less sharply-defined depression. Cheeks convex to the marginal border, the eyes opposite the third pair of lateral glabellar furrows. Facial sutures making a sigmoidal curve from the anterior margin of the head to the front of the eye-lobe, and after passing around the eye, bending outward and cutting the flattened border being smooth within, but toward the margin covered with fine, raised tubercles and elongate flexuose markings.

The dimensions of an average-sized pygidium are: length, 10 mm.; width, 13 mm.; and convexity, 4.5 mm. A rather small head is 7 mm. long on the median line and probably 11 mm. wide, but some fragmentary specimens must have been more than twice this size when complete.

Remarks.—Fragments of the head and pygidium of this species are not uncommon in the coralline layer at the Nearpass cliff. The species was first recognized and named by Dr. Barrett, but no proper description of it was ever given.

PROETUS? DEPRESSUS n. sp.

Plate XXII., Fig. 27.

Description.—Known only from the pygidium, which is semi-circular in outline. The axis is depressed, about five-sixths the total length of the pygidium, with about ten segments; occupying one-third the width of the pygidium anteriorly, tapering rather abruptly posteriorly, where it is bluntly rounded, the lateral, bounding furrows continuing indefinitely to the posterior margin of the pygidium. Pluræ flattened adjacent to the axis, convex toward the border, with a slight, concave furrow within the convex marginal border; marked by six grooved segments on each side, the grooves being located centrally and being fully as deep as the furrows between the segments, but not extending across the marginal border. The bounding furrows of the segments are continued as faint, ill-defined grooves across the marginal border.

The dimensions of the largest and best specimen observed are: length, 5.5 mm., and width, 9 mm.

Remarks.—This species, so far as it has been observed, resembles *Proetus protuberans* Hall, from the Coeyman's limestone of the Helderbergian period. The Decker Ferry specimens differ from *P. protuberans* in having a less conspicuous marginal border and in having a larger number of segments on both axis and pluræ of the pygidium.

PROETUS? SPINOSA n. sp.

Plate XXII., Fig. 26.

Description.—Pygidium semi-circular in outline, rather strongly convex, with a very slight, blunt point posteriorly. Axis with eight well-defined segments; occupying about one-third of the entire width of the pygidium anteriorly, tapering regularly to the posterior extremity, which is bluntly rounded and lies within the marginal border. Pluræ convex, marked by six well-defined, grooved segments, curving rather abruptly to the margin, with a concave furrow within the narrow marginal border.

The dimensions of the best-preserved specimen are: length, 10 mm.; width, 13 mm.

Remarks.—This trilobite is represented only by several pygidia, most of which are but fragmentary. It apparently belongs to some species of *Proetus* or, perhaps, *Phacops*, but the material is not sufficient for certain generic identification.

CALYMENE CAMERATA Con.

Plate XXII., Figs. 22–25.

1842. *Calymene camerata* Con., Jour. Acad. Nat. Sci. Phil., vol. VIII., p. 278.

ws longer than the second, indefinitely divided within and surround-
g a small tubercle on the side of the glabella; the posterior division
rected more obliquely backward than the outer portion and continued
a slight, indefinite depression to the occipital furrow. Posterior
teral lobes large, subglobose. Occipital furrow rather narrow and
ep across the axial portion of the head, becoming broader on the
eeks; occipital segment convex, broadest in the middle. Cheeks
nvex, the eyes opposite the second lateral lobes of the glabella.
ygidium subtriangular in outline, much elevated anteriorly, sloping
ruptly to the sides and back; axis occupying about one-third of
e width in front, bounded by the depressed, dorsal furrow, tapering
radually to the obtusely-rounded extremity which is close to the
sterior margin of the pygidium; divided into about eight segments.
luræ sloping abruptly from the axis to the sides, divided into five
rooved segments. A small hypostome, which accompanies the speci-
ens of this species and which probably belongs to it, is longer than
ide, with the sides sinuate, making the middle portion much nar-
wer than either of the extremities; the posterior margin is notched
d the centre of the axial portion is elevated into a conspicuous,
iniform process. The entire surface of both head and pygidium, so
r as preserved, except in the furrows, is covered with numerous,
nall, irregularly-arranged, rounded papillæ.

The dimensions of the best-preserved head are: length, 14 mm.;
idth, 26 mm. Another much larger individual has a length of 23
m., but the width cannot be determined. The dimensions of a
nall pygidium are: width, 10.5 mm.; length, 6 mm.; convexity, 7
m. Some of the larger, fragmentary specimens of pygidia are fully
rice this size.

Remarks.—In his illustrations of this species Hall shows three
arply-defined pairs of lateral glabellar lobes. In the New Jersey
ecimens these three pairs of lobes may all be detected, but the
nterior pair is so inconspicuous as to be easily overlooked, and in
o case has it been seen at all approaching the prominence given it
y Hall's illustrations. In his description of the species the anterior
bes are said to be minute, and it is probable that they were made too
rominent in the illustrations. All the material representing the
pecies from New Jersey is fragmentary and unsatisfactory for study,
ut there can be no doubt as to its correct identification.

DALMANITES ASPINOSA n. sp.

Plate XXII., Fig. 15.

Description.—Known only from the pygidium, which is longitudinally semi-elliptical in outline, obtusely pointed posteriorly. Axis regularly tapering and rounded posteriorly; in the type specimen reaching to within 4.5 mm. of the posterior margin, which makes it about sixth-sevenths of the entire length of the pygidium; marked by about sixteen annulations, which gradually decrease in size posteriorly, until they become entirely obsolete. The pluræ are rather strongly convex to the margin, with no flattened or concave border; marked by ten prominent, narrow, grooved ribs, which extend to the margin of the pygidium and are separated by broad, concave furrows.

The dimensions of the type specimen are: length, 32 mm.; width, 40 mm.; convexity, 9 mm.

Remarks.—The only specimen of this species in the collection which is in any degree complete is an internal cast of the pygidium. This specimen, however, preserves essentially all the characters of the pygidium, though another specimen, not a cast, would show the pleural ribs to be somewhat broader. The species differs somewhat conspicuously from any of the other Silurian members of the genus in the American faunas, and may be recognized by the absence of any spinous extension from the posterior extremity, by the absence of any flattened or concave marginal border and by the sharp pleural ribs, which extend to the border of the pygidium.

erior margin narrower and often more sharply rounded than the erior. Eye tubercle small, but rather prominent, situated at a t about one-third the length of the straight dorsal margin from anterior end and about three-fourths of the height of the valve at point from the basal margin. Surface of the valves flattened he antero-dorsal angle, the flattening extending as a narrow, indis- t, marginal border nearly to the centre of the anterior margin. ng the posterior margin there is a similar, narrow, indistinct, tened border, which extends from the postero-dorsal angle to a t in the ventral margin directly below. Surface of valves per- ly smooth.

he dimensions of an average specimen are: length, 7 mm.; height, mm.; convexity of one valve, 1.5 mm.

emarks.—This species most closely resembles *L. alta* of the Man- limestone, but may be always distinguished from that species by indistinct, posterior marginal border. It also resembles *L. jonesi*, does not have the pitted surface of that species.

BEYRICHIA SUSSEXENSIS n. sp.

Plate XXIII., Figs. 3–4.

escription.—Carapace subelliptical in outline; the dorsal margin ight, its length about nine-tenths of the total length of the valves, xtremities angular. Ventral margin gently convex; the anterior posterior margins both broadly rounded, the posterior extremity g a little higher than the anterior and its margin being nearly ight for a short distance below the postero-dorsal angle. The re free margin of the valves with a distinct, flattened, marginal ler, which is abruptly separated from the body of the valve. The sal half of the surface of each valve is divided into three lobes by deep furrows, which reach to about the middle of the valve. The erior furrow divides the valve at about the middle of its length is nearly straight; the anterior furrow lies about half way be- en the posterior one and the anterior extremity; it is a little ter than the other and its lower extremity is slightly bent back- d. The two furrows are connected below by an indistinct de- sion in the valve, partially isolating the middle lobe. The anterior posterior lobes are connected ventrally. The middle lobe is subglobose and is the most prominent of the three; the posterior lobe is a little more prominent than the anterior. The entire surface, except in the furrows and on the marginal border, is finely papillose.

The dimensions of the type specimen are: length, 3 mm.; height, 1.8 mm.

BEYRICHIA BARRETTI n. sp.

Plate XXIII., Fig. 9.

Description.—This species resembles the last, but is smaller, with the anterior furrow narrower and with the posterior one produced further toward the ventral margin, giving to the median lobe a more elliptical outline. The surface is also very differently marked, it being covered with rather large, irregular pits. The ventral margin is nearly straight in the central portion, the anterior and posterior extremities of the valve being of nearly equal height.

The dimensions of the type specimen are: length, 2.3 mm.; height, 1.5 mm.

BEYRICHIA PERINFLATA n. sp.

Plate XXIII., Fig. 6.

tuberance is partially separated from the anterior lobe in front and the posterior lobe behind by a slight depression in the surface of the valve, which is continuous with the oblique portion of the anterior furrow. Surface of valves, except in the furrows and on the marginal border, minutely pustulose.

The dimensions of the type specimen are: length, 3.1 mm.; height, 2.2 mm.

BEYRICHIA JERSEYENSIS n. sp.

Plate XXIII., Fig. 5.

Description.—Carapace subelliptical in outline, height in front and behind nearly equal. Hinge-line straight, about two-thirds the length of the valve. Free margin with a narrow, marginal border, which is flattened above and drops vertically to the edge of the valve externally. Valve divided near the middle by a narrow furrow, starting from the hinge-line and extending to below the middle of the valve, with a slight, forward curve. A second furrow originates from the median furrow a little below the hinge-line and, after describing nearly a semicircle towards the front of the valve, again joins the median furrow a little above the middle of the valve. The lower half of this semicircular furrow is less deeply impressed than the upper, and a faint depression joins its upper portion with the dorsal margin of the valve. Surface of the valve smooth, regularly convex throughout, with the median, semi-circular lobe slightly more prominent.

The dimensions of the type specimen are: length, 2.5 mm.; height, .5 mm.

BEYRICHIA NEARPASSI n. sp.

Plate XXIII., Figs. 7–8.

Description.—Carapace subelliptical in outline, the posterior extremity equaling or a little narrower than the anterior; the hinge-line straight, about four-fifths of the total length of the valves. Free margin, with a flattened, marginal border. Valves divided into three lobes by two rather-broad and deeply-impressed, nearly-equal furrows, which start from the dorsal margin and extend vertically downward to about the middle of the valve. A shallower and less sharply-defined furrow extends vertically upward from the ventral margin, directly beneath the anterior furrow from the dorsal margin, the two being indefinitely connected across the middle of the valve by a slight depression. The posterior lobe is strongly convex and is the largest of the three, occupying about one-half of the total length of the valve; medial lobe subglobular, about as high as the posterior one; anterior lobe about the same width as the median one, but less strongly convex. Entire surface of the valves smooth.

The dimensions of an average specimen are : length, 1.75 mm; height, 1 mm.

BEYRICHIA DECKERENSIS n. sp

Plate XXIII., Fig. 11.

Description.—Carapace subelliptical, a little narrower in front, hinge-line straight, a little more than four-fifths the total length of the valve. Free margin depressed in a narrow border from the postero-dorsal angle around the posterior margin, ventrally and anteriorly the body of the valve is slightly inflated so as to project beyond the marginal border, entirely hiding it in a direct view. Valves divided into three lobes, by two vertical furrows, extending downward from the dorsal margin; the posterior furrow is the strongest, and extends beyond the middle of the valve, being but slightly curved forward below; the anterior furrow is shorter, and its lower extremity curves backward. The posterior lobe is strongly convex, and occupies about one-half of the entire valve; the median lobe is subglobular,

BYTHOCYPRIS NEARPASSI n. sp.

Plate XXIII., Fig. 12.

Description.—Carapace suboval in outline, twice as long as high, uch narrower in front. Ventral margin nearly straight, dorsal argin gently convex, posterior margin broadly rounded, anterior argin narrowly rounded. Valves strongly convex, their surface mooth. The left valve overlapping the right along both the dorsal nd the ventral margins.

The dimensions of one of the type specimens are: length, 1.33 mm.; eight, 0.66 mm.

Uncertain Species.

In addition to the species enumerated, there are several forms o imperfectly preserved for identification or description. Several pecimens are fragments of a horn coral, but the preservation is not ch as to allow even the genus to be determined with certainty, lthough it is probably a *Zaphrentis*. Several additional pelecypoda, ost of them in a very imperfect state of preservation, have been bserved. One of these is the anterior extremity of a small shell, ith conspicuous, concentric markings, like those on *Grammysia* or *llorisma*. Another specimen is apparently an imperfect *Orthoceras*, though no sutures can be detected.

DESCRIPTIONS OF SPECIES IN THE RONDOUT FAUNA.

PROTOZOA.

FORAMINIFERA.

In the "pethstone" bed (2 A^{19} of the Nearpass section) of the ondout formation small, subglobular or more or less irregular bodies ay sometimes be detected, which are not certainly organic, but which uggest some forms of foraminifera. It is possible that they are the fossil remains of some of these lowly organisms.

MOLLUSCOIDEA.

BRACHIOPODA.

HYATTELLA? LAMELLOSA n. sp.

Plate XXIII., Figs. 15–18.

Description.—Shell small, transversely subelliptical in outline. Pedicle valve prominent on the umbo; the beak blunt, not strongly incurved; the surface curving rather abruptly from the umbo to the cardinal margin, and sloping gently, with a slight convexity, to the lateral margins; toward the front it is deeply depressed in a broad, somewhat flat-bottomed sinus, which reaches to the umbo. Brachial valve strongly convex, most prominent near the middle; the mesial fold not strongly elevated above the general surface, with a slight, depressed, mesial line. Surface of both valves marked by strong and broad, concentric, lamellose lines of growth.

The dimensions of the type specimen are: length, 6 mm.; width, 7 mm.; thickness, 4 mm.

Remarks.—This species is established on a single, nearly-perfect individual, which is of interest, because it is the only specimen of

ARTHROPODA.

OSTRACODA.

LEPERDITIA ALTA (Con).

See, also, p. 265, pl. XXIV.

In some beds of the Rondout formation there are numerous crushed specimens of a species of *Leperditia,* which, so far as can be determined, possess the characters of *L. alta,* the species which is so abundant in the Manlius limestone, or of *L. altoides,* from the base of the Decker Ferry formation.

LEPERDITIA ELONGATA n. sp.

Plate XXIII., Fig. 13.

Description.—Carapace large, obliquely subreniform, posterior extremity the highest. Dorsal margin straight, two-thirds of the total length of the valves, its extremities obtusely angular. Anterior margin obliquely truncate from the hinge-line, sharply rounded in front into the broadly-convex ventral margin, which, in turn, curves regularly into the nearly semi-circular posterior margin. Eye tubercle distinct, situated a little above the middle of the antero-dorsal quarter of the valves. Both anteriorly and posteriorly the margin is slightly flattened in a rather indistinct marginal border, extending from the extremities of the hinge-line to the middle of the valve. Surface smooth.

The dimensions of an average specimen are: length, 12 mm.; height, 6.5 mm.; convexity of one valve, 2.5 mm.

Remarks.—This species resembles *L. alta,* but is larger and more elongate.

LEPERDITIA GIGANTEA n. sp.

Plate XXIII., Fig. 14.

Description.—Carapace very large, subreniform in outline. Dorsal margin straight, about three-fifths of the total length of the valves, its anterior extremity obtusely angular, its posterior extremity rounding into the nearly semi-circular posterior margin. Ventral margin gently convex, anterior margin broadly rounded, nearly as high as the posterior margin. Eye tubercle distinct, situated at about the middle of the antero-dorsal quarter of the valves; behind the eye tubercle there is a broad, shallow, indistinct, flattened sulcus, which extends downward from the hinge-line nearly to the centre of the valve. The antero-dorsal angle is distinctly compressed, and the flattened area extends around the anterior margin as a marginal border. The posterior margin is also bordered by a more or less distinct, flattened border. Surface smooth.

The dimensions of a large specimen are: length, 22.5 mm.; height, 14 mm.; convexity of one valve, 6 mm.

Descriptions of Species in the Manlius Limestone Fauna.

MOLLUSCOIDEA.

BRACHIOPODA.

STROPHEODONTA VARISTRIATA (Con.).

Plate XXIV., Figs. 13–14.
See, also, p. 274.

1859. *Strophodonta varistriata* Hall, Pal. N. Y., vol. III., p. 180, pl. 8, figs. 1–16, pl. 16, figs. 1–8.

Description.—Shell concavo-convex, subcircular, subelliptical or subquadrangular in outline, length equal to, less or greater than the width, hinge-line equaling, less or greater than the width, cardinal extremities rounded or angular. Pedicle valve depressed-convex, umbonal region rather prominent, beak extended a little beyond the hinge-line, arched over the narrow, cardinal area. Brachial valve concave or nearly flat. Surface of both valves marked by fine, sharp, radiating striæ, which vary in size, the stronger ones usually being equidistant, with several finer ones between. Crossing the radiate markings are much finer, somewhat undulating, concentric lines.

The dimensions of an average specimen from the Manlius limestone are: length, 17 mm.; width, 19 mm.

Remarks.—Every specimen of the genus *Stropheodonta* which has been observed in the Manlius limestone seems to be referable to this variable species. Its most constant characteristic is to be found in the surface markings, the proportionate dimensions of the shell being different in almost every individual.

CENTRONELLA? BIPLICATA n. sp.

Plate XXIV., Figs. 1–8.

Description.—Shell small, longitudinally subovate in outline, the valves subequally convex. Pedicle valve with a sharply-pointed, arched beak, the mesial sinus narrow, shallow and extending nearly to the beak, but becoming very indistinct or almost obsolete back of the middle of the shell; it is limited on each side by a single, low, rounded plication, which is not conspicuous, except near the anterior margin. The brachial valve with a low, rounded, median fold near the anterior margin, bounded by a shallow, rounded furrow on each side and not rising above the general surface of the valve. Internally it bears a short, Centronella-like brachidium. Besides the two plications which bound the fold and sinus, each valve, in the larger individuals, is marked by one or two additional, extremely-faint plications near the margin on each side and by more or less indistinct lines of growth.

The dimensions of a rather large specimen are: length, 4.75 mm.; width, 3.5 mm.; thickness, 2 mm.

Remarks.—This little shell is probably not a member of the genus *Centronella,* but its brachidium, as seen in transparent or translucent specimens, is similar to the loop of this genus, and therefore it is placed here provisionally. In external form the shell differs materially from the typical members of the genus, and, in fact, it differs in external form from all the genera of the family *Centronellidæ.* With a more perfect understanding of the loop of this shell, it is entirely probable that it would constitute the type of a new genus.

In certain layers of the Manlius limestone in the Nearpass quarry this little shell occurs in great numbers, many of which can be removed from the rock in perfect condition. In the smaller or younger specimens of the species the two plications near the front margin are very faint or entirely obsolete, but in full-grown individuals they can always be detected.

SPIRIFER VANUXEMI Hall.

rounded or slightly-flattened plications on each side of the fold and sinus and by conspicuous, more or less crowded, concentric lines, which are arched over the plications. Besides these markings, very fine, radiating striæ may be detected on well-preserved specimens by the aid of a magnifying glass.

The dimensions of a rather large pedicle valve are: length, 10 mm.; width, 11.5 mm.; convexity, 4.5 mm. Those of a brachial valve are: length: 7.5 mm.; width, 11 mm.; convexity, 2.5 mm.

Remarks.—This is one of the most characteristic species of the Manlius limestone fauna, and occurs throughout the formation, being especially abundant in some of the beds.

MOLLUSCA.

PELECYPODA.

MEGAMBONIA AVICULOIDEA Hall.

Plate XXIV., Figs. 17–18.

1859. *Megambonia aviculoidea* Hall, Pal. N. Y., vol. III., p. 274, pl. 49, figs. 7 *a–b*, pl. 49 *A*, fig. 8.

Description.—Shell oblique, winged posteriorly. Beaks nearly terminal, prominent, obtuse, incurved, elevated above the hinge-line. Hinge-line straight; anterior margin curving forward from beneath the beaks for a short distance, then curving backward, with a long, gentle sweep, to the postero-basal extremity, which is more or less broadly rounded; posterior margin sinuate below the hinge extremity, convex towards the base. Surface of valves strongly convex on the umbonal ridge; the anterior slope rather abrupt, slightly convex; posterior slope concave, the posterior wing not sharply separated from the body of the shell. Surface marked by fine, more or less unequal, concentric lines of growth, which are uniform in character upon the body of the shell and the posterior wing.

The approximate dimensions of an imperfect specimen are: height, 16 mm.; length, 16 mm.

GASTROPODA.

HOLOPEA ANTIQUA (Van.).

Plate XXIV., Figs. 15–16.

1859. *Holopea antiqua* Hall, Pal. N. Y., vol. III., p. 294, pl. 54, fig
2 *a–b*, 3 *a–b*.

Description.—Shell subconical, spire elevated, with four or mo volutions. Suture moderately impressed, the volutions regularly co vex. Aperture ovate or subcircular. Surface marked by fine, tran verse lines of growth.

Remarks.—The specimens which have been referred to this specie are all imperfect, and are usually only the internal casts. The apica angle of the New Jersey specimens apparently varies between 55° an 60°, which is somewhat less than that of Hall's illustrations of t species, in which it measures nearly 70°. This measurement of t New Jersey specimens, however, cannot be made with certainty, b cause in no case is the complete spire retained.

PTEROPODA

TENTACULITES GYRACANTHUS (Eaton).

Plate XXIV., Figs. 19–20.

[redacted] N. Y., vol. III., p. 13

The maximum diameter of internal casts of this species is about 1 mm., though specimens with the shell preserved sometimes attain a diameter of 1.5 mm.

Remarks.—As it occurs in New Jersey, this species has been observed only in the form of internal casts, but the irregular length of the interspaces between the annulations is sufficient to distinguish the species. It has never been observed to occur in such abundance in New Jersey as it sometimes does in the Manlius limestone of New York.

CEPHALOPODA.

ORTHOCERAS sp. undet.

Plate XXV., Fig. 1.

A single weathered specimen of a large *Orthoceras* has been observed in the Manlius limestone fauna of New Jersey. It has a maximum diameter of about 53 mm. and a total length of 270 mm. The septa are rather deeply concave, and in the larger portion of the shell they vary from 6 mm. to 9 mm. apart; at the smaller extremity of the shell they are sometimes as close together as 2.5 mm. The siphuncle is apparently central, and has a diameter of about 2.5 mm. The external surface characters cannot be determined.

ARTHROPODA.

OSTRACODA.

LEPERDITIA ALTA (Con.).

Plate XXIV., Figs. 25–28.

1859. *Leperditia alta* Hall, Pal. N. Y., vol. III., p. 373.

Description.—Carapace obliquely subreniform, valves strongly convex, gibbous in the middle, somewhat variable in their proportions. Dorsal margin straight, from three-fifths to two-thirds the total length of the valves; its extremities obtusely angular. Posterior margin broadly rounded, ventral margin convex, anterior margin more sharply rounded than the posterior. Eye tubercle distinct, situated at about the centre of the antero-dorsal quarter of the valve. Anterior margin slightly flattened at the dorsal angle, the flattened area sometimes extended for a short distance as a marginal border. Surface of the valves smooth.

The dimensions of an average specimen are: length, 7 mm.; height, 4.5 mm.; convexity of one valve, 2 mm.

Remarks.—This species occurs abundantly in the Manlius limestone, where it is one of the most characteristic species.

BEYRICHIA KÜMMELI n. sp.

Plate XXIV., Fig. 21.

Description.—Carapace subelliptical in outline, a little narrower in front, hinge-line straight, about three-fifths of the total length. Free margin with a depressed, concave border, whose outer edge is slightly elevated in a rounded, marginal ridge, outside of which the surface drops abruptly to the edge of the valve. Valve divided into three lobes by two furrows, which extend ventrally downward from the hinge-line to about the middle of the valve; the anterior furrow a little shorter than the other, with its lower extremity slightly curved backward. Posterior lobe the largest, including nearly one-half of the valve, with a small, but distinct, tubercle a little in front of its middle point. Middle lobe subglobular in form, more highly convex than either of angle, curving below into the convex, ventral margin; anterior in broadly rounded, meeting the hinge-line in an obtuse angle. margin with a narrow, flattened border. Valve divided into three by two vertical furrows from the dorsal margin; the posterior ›w extending nearly to the middle of the valve, its lower extremity tly curved forward; anterior furrow less deeply impressed, only t one-half as long as the posterior one. Posterior lobe occupying y one-half the total length of the valve; middle lobe subglobular, t as high as the posterior one; anterior lobe sloping away to the :. Surface marked by fine, closely-arranged, circular pits, except e furrows and on the marginal border.

ıe dimensions of the type specimen are: length, 1.9 mm.; height, n.

BEYRICHIA MONTAGUENSIS n. sp.

Plate XXIV., Fig. 23.

scription.—Carapace suboval in outline, narrower in front, the ›-line straight, about five-sixths of the entire length of the valve. ›ro-dorsal angle a little produced, so that the posterior margin is tly concave above. Free margin with a rather broad, flat border. ›s divided into three lobes by two furrows, which extend vertically ward from the dorsal margin; the posterior furrow the longer, ıing a little below the middle of the valve, its lower portion tly curved toward the front; anterior furrow scarcely reaching niddle of the valve, slightly curved, with its concave side pos-:, a little narrower and less deeply impressed than the posterior Posterior lobe convex, occupying about one-half of the length .e valve; middle lobe the most prominent, subglobose; anterior the lowest of the three, its surface sloping to the anterior border. ace of the valve minutely pitted or punctate, except in the fur- and on the marginal border.

ıe dimensions of the type specimen are: length, 2.4 mm.; height, am.

BEYRICHIA SMOCKI n. sp.

Plate XXIV., Fig. 24.

Description.—Carapace subelliptical in outline, a little narrower in front, hinge-line straight, about nine-elevenths of the total length of the valve. Free margin depressed, with a narrow, concave furrow within, which is bordered externally by a narrow, rounded elevation, outside of which the surface drops abruptly to the edge of the valve. Along the postero-ventral margin the border is hidden for a short distance by the protrusion of the body of the valve. Valves divided into three lobes by two vertical furrows; the posterior furrow longest, reaching below the middle of the valve, its lower portion slightly curved toward the front; anterior furrow narrower, shorter and deeply impressed, curving backwards. Posterior lobe strongly convex, its greatest elevation nearest its anterior margin; median lobe subglobular, about as highly elevated as the posterior one; anterior lobe much lower, sloping gently to the anterior margin. Surface of valves smooth.

The dimensions of the type specimen are: length, 2.6 mm.; height, 1.5 mm.

BEYRICHIA MANLIENSIS n. sp.

Plate XXIII., Fig. 10.

CHAPTER IX.

FAUNAS OF DEVONIAN AGE.

All the Paleozoic formations in New Jersey lying above the Manlius limestone are referable to the Devonian period. The formations recognized are the Coeymans limestone, the New Scotland beds, the Becraft limestone and the Kingston beds belonging to the Helderbergian series. Following these is the Oriskany formation, with its beds of siliceous limestones and sandstone; then comes the Esopus slate, followed by the Onondaga limestone. All these formations occur in the Delaware Valley region. In the Green Pond region there are some still younger Devonian formations. The Newfoundland grit is usually a quartzite with fossils of Onondaga age; following this are the Monroe shales and Bellvale flags of Hamilton age, and the Skunnemunk conglomerate, which is undoubtedly Devonian in age, although it has not been found to be fossiliferous.

In the Helderbergian series only two faunas have been differentiated and described separately, they being the Coeymans limestone fauna and the New Scotland-Becraft fauna, the faunas of the two latter formations having so much in common, although each has some peculiar species, that it has been thought best to include them together in one faunal group. The Kingston beds have not been found to be fossiliferous in New Jersey, unless the "trilobite bed" characterized by *Dalmanites dentatus* should be considered as the summit of the ormation. This bed, however, contains so many species allying it with the superjacent Oriskany that it has been considered as being of ower Oriskany age, and its fauna is treated separately. The higher Oriskany faunas, although two distinct faunal zones may be easily recognized, are all described together. The Esopus slate is unfossiliferous, and the fauna of the Onondaga limestone is a small one. From the Green Pond region the fauna of the Newfoundland grit is treated by itself, while those of the Monroe shales and Bellvale flags are described together.

DESCRIPTIONS OF SPECIES IN THE COEYMANS LIMESTONE FAUNA.

COELENTERATA.

ANTHOZOA.

ZAPHRENTIS ROEMERI E. & H.?

Plate XXVI., Fig. 1.

Specimens of horn corals, which may be provisionally referred to the genus *Zaphrentis*, are occasionally met with in the Coeymans limestone. They are all poorly preserved, and are not in a condition of preservation for accurate identification, but some specimens seem to resemble *Z. roemeri*.

FAVOSITES HELDERBERGIAE Hall.

1887. *Favosites helderbergiæ* Hall, Pal. N. Y., vol. VI., p. 8, pl. 4, figs. 1–2, pl. 5, figs. 1–3, pl. 6, figs. 1–8.

Description.—Corallum consisting of large, lenticular, depressed-characterizes a conspicuous coral bed. The New Jersey specimens are always more or less completely silicified, and have been altered so that the mural pores can rarely be detected, even in thin sections.

CLADOPORA MULTISERIATA n. sp.

Plate XXVI., Figs. 2–3.

Description.—Corallum consisting of cylindrical branches, which occasionally divide. Corallites cylindrical, directed obliquely to the axis of the branches, apparently free from septa or tabulæ, arranged in twelve or thirteen vertical series; the apertures in adjacent series being more or less irregularly alternate. Because of the obliquity of the corallites, their apertures are elliptical, the peripheral borders regular, subangular.

The diameter of the branches is from 2 mm. to 3.5 mm., with six or seven corallites occupying a space of 5 mm. longitudinally.

Remarks.—This species has only been recognized in the upper beds of the formation near Hainesville.

HYDROZOA.

STROMATOPORA CONCENTRICA Goldf.

Masses of a Stromatoporoid, which may provisionally be referred to *Stromatopora concentrica,* occur more or less abundantly in the coral bed at the base of the Coeymans limestone. They are always more or less silicified, so that they are not in a proper condition for study, and no correct identification of either the genus or the species can be made. The form may always be recognized by the more or less subglobular form of the masses, with their concentric, laminar structure.

VERMES.

ANNELIDA.

CORNULITES CINGULATUS Hall.

Plate XXXII., Fig. 3.

1888. *Cornulites cingulites* Hall, Pal. N. Y., vol. V., pt. II. (vol. VII., suppl.), p. 20, pl. 116, fig. 29.
1900. *Cornulites cingulites* Clarke, Mem. N. Y. St. Mus., No. 3, vol. III., p. 27, pl. 2, figs. 35–38.

Description.—Shell having the form of a gradually-tapering, more or less curved or flexuose, annulated cone. On the internal casts the annulations have the aspect of insheathed cones, the slope being abrupt below and gradual above. The width of the annulations is variable, but is usually a little less than one millemeter; they are somewhat irregular, there occasionally being one which does not entirely surround the tube.

The dimensions of the best specimen observed, which is nearly straight and incomplete at its smaller extremity, are: length, 14.5

mens observed have separated, is marked by more or less irregular concentric lines, which follow the direction of the lobate distal margin. The zoœcia are arranged in longitudinal rows, additional rows being rarely intercalated, except along the lines dividing the lobes of the frond; in tangential section they are seen to be elliptical in outline, with their longer axis parallel with the zoœcial rows; those in adjacent rows are alternate in position, so that they appear, also, to be arranged in diagonal lines. The lobation of the zoarium introduces some irregularity in the arrangement of the zoœcia along the lines separating the lobes, the parallel lines of openings in each lobe having a different direction, and the openings themselves often being more or less oblique. In vertical section the outer portions of the zoœcia are seen to be at nearly right angles to the mesotheca, the basal portion being slightly procumbent; diaphrams are entirely absent, but the superior hemisepta are uniformly present.

Remarks.—As it occurs in the Coeymans limestone in New Jersey, split along the mesothecal wall, this species resembles *P. frondosa* of the Decker Ferry formation, but it may always be distinguished from that species by its lobed distal margin, and in thin sections by the absence of diaphrams. It also resembles *P. nebulosa* Hall, from the Helderbergian of New York, but the internal characters of that species have never been described; that species, however, is not described as being lobate, and in *P. lobata* there are no monticules with larger zoœcia shown in the tangential sections.

LICHENALIA TORTA Hall.

Plate XXVI., Figs. 7–8.

1887. *Lichenalia torta* Hall, Pal. N. Y., vol. VI., p. 31, pl. 15, figs. 1–5, 7.

Description.—"Zoarium consisting of lamellate expansions, sometimes flat, at other times more or less involuted or contorted. Under surface a thin epitheca, marked by concentric wrinkles and striæ, with fine, radiating striæ. When the celluliferous tissue of the bryozoum has been removed, the radiating striæ on the upper surface of the epitheca are very sharp and prominent, and at their junction with the concentric striæ form minute nodes. Cell apertures broadly oval or circular, sometimes subtriangular or trilobate; diameter 0.30 mm.; space between adjacent apertures equal to or less than the diameter of an aperture. Anterior margin slightly elevated, posterior side strongly elevated, with two slight denticulations. Surface with slightly-elevated monticules."—*Hall.*

MONOTRYPA SPHAERICA (Hall).

Plate XXVI., Figs. 9–11.

1887. *Favosites sphæricus* Hall, Pal. N. Y., vol. VI., p. 9, pl. 7, figs. 1–12, pl. 8, fig. 8.

Description.—Zoarium massive, subhemispheric or explanate in form, with monticules situated at distances of about 5 mm. Zoœcia polygonal, thin walled, the larger ones 0.5 mm. in diameter and the smaller ones less than 0.25 mm. In the thin, tangential sections the monticules are represented by groups of larger zoœcia, with a few much smaller ones interspersed, which appear as scattered mesopores. From the centres of these groups the size of the zoœcia gradually diminish to the middle of the interspaces, where the smallest ones occur. The diaphragms are flat and horizontal, averaging about two tube diameters apart, though frequently they are much closer together.

Remarks.—More than one distinct form has probably been confused convex, in the variety *arata* much more so, and they are apt to have a proportionately greater width. The surface markings are also different, although in both forms they consist of alternating larger and smaller ridges or striæ. In the Coeymans limestone specimens there is a greater difference between the coarse and fine markings, the coarser ridges being less sharply angular, with about five or six exceedingly fine filiform striæ in the intervening spaces. In the Manlius limestone specimens the median portion of the pedicle valve is usually rather broadly flattened toward the front, while in the Coeyman's limestone individuals no such flattening is observable. The average forms in the two faunas certainly exhibit sufficient differences to be ranked as distinct species, although they are doubtless genetically related, and are probably connected by intermediate forms. The material in the New Jersey collections is not sufficiently well preserved nor sufficiently abundant to permit the proper limitations and relationships of these forms to be shown, but with the proper material for study it is quite probable that it would be found necessary to recognize two distinct species now included in *Strophedonta varistriata.*

STROPHEODONTA VARISTRIATA var. ARATA H.

Plate XXVII., Fig. 3.

1859. *Strophodonta varistriata* var. *arata* Hall, Pal. N. Y., vol. III., p. 183, pl. 18, figs. 1 *a–i.*

Description.—The shell referable to this variety is closely related to, and grades into, the typical Coeymans limestone form of *S. varistriata.* It is a more convex and porportionately wider shell, with the coarser, radiating ridges more angular and stronger, with a smaller number of intervening, finer striæ, which are really placed upon the sloping sides of the larger ridges, instead of upon a flattened area between adjacent ones.

STROPHEODONTA PLANULATA Hall.

Plate XXVII., Figs. 1–2.

1859. *Stropheodonta planulata* Hall, Pal. N. Y., vol. III., p. 184, pl. 16, figs. 9–12.

Description.—Shell plano-convex, subsemi-elliptical in outline, wider than long, the hinge-line equal to, a little greater or a little less than the width of the shell below. Pedicle valve depressed-convex, slightly flattened toward the cardinal extremities, the beak not prominent; cardinal area narrow, linear. Brachial valve flat. Surface marked by fine, rounded, bifurcating striæ, which become strongly curved as they approach the cardinal margin, about five or six of them occupying the space of 2 mm. on the margin. These radiating markings are crossed by much finer, concentric striæ, which are only visible through a magnifying glass, and by a few inconspicuous lines of growth.

The dimensions of a rather small specimen are: length, 28 mm.; width, 32 mm.; convexity, 2.5 mm.

STROPHEODONTA INDENTA (Con.).

Plate XXVI., Fig. 12.

1838. *Leptæna indenta* Con., 2d Ann. Rep. N. Y. Geol. Surv., p. 117.

Remarks.—Conrad's original description of *Leptæna indenta* was very meagre, and Hall included the species in *Stropheodonta varistriata.* In his bibliographic list, however, Schuchert has recognized it as a distinct species, and doubtless he is correct in so doing. None of the New Jersey specimens identified with this species are as large as the one described by Conrad, which is said to be three-fourths of an inch in length, but they are all very characteristically marked by the strong, transverse indentations in the radiating furrows, and may always be recognized by this character.

STROPHONELLA PUNCTULIFERA (Con.).

Plate XXVII., Figs. 6–8.

159. *Strophodonta punctulifera* Hall, Pal. N. Y., vol. III., p. 188, pl. 21, figs. 4 *a–b,* pl. 23, figs. 4 *a–c,* 5 *c,* 7 *e.*

Description.—Shell subsemi-circular in outline, strongly concavo-convex, the hinge-line about equaling the greatest width. Pedicle valve slightly convex on the umbo, then becoming strongly concave to the lateral and front margins; the cardinal area narrow; the beak inconspicuous, scarcely projecting beyond the hinge-line. Brachial valve slightly concave on the umbo, then becoming strongly convex or geniculate towards the lateral and front margins, following somewhat closely the curvature of the opposite valve. Surface of both valves marked by strong, angular, raised, radiating striæ, which increase by bifurcation and implantation; becoming finer toward the margins. On well-preserved specimens these striæ are seen to be punctate. The interior surface of the valves is pustulose, giving to the surface of internal casts a pitted appearance.

The dimensions of an average-sized individual are: length, 33 mm.; width, 50 mm.

Remarks.—This shell is always poorly preserved, the best specimens observed being but fragmentary. It can be easily recognized, however, in most cases, by its strong, angular, radiating markings and by the strongly-pitted surface of internal casts.

ORTHOTHETES WOOLWORTHANA (Hall).

Plate XXVII., Fig. 5.

1859. *Strophomena woolworthana* Hall, Pal. N.Y., vol. III., p. 192, pl. 17, figs. 1 *a–t*, 2 *a–c*.

Description.—Shell longitudinally semi-elliptical, hinge-line equaling the greatest width. Pedicle valve slightly convex or flattened on the umbo, concave toward the front, marked interiorly by a broad, flabellate, muscular impression; the beak elevated, but scarcely projecting beyond the cardinal line; cardinal area flat, rather high; delthyrium broadly triangular, closed by a deltidium. Brachial valve convex, flattened on the umbo, most elevated toward the front. Surface of both valves marked by angular, raised, radiating striæ, which are crossed by fine, concentric striæ and by a few more conspicuous lines of growth.

The dimensions of an average specimen are: length, 32 mm.; width, 34 mm.

LEPTAENA RHOMBOIDALIS Wilck.

Plate XXVII., Fig. 9.
See, also, pp. 228, 302, 325, 366.

defined sinus, which is usually deeper on the two sides, with a rounded elevation in the middle, giving to the shell the appearance of having a double sinus. The beak is of moderate prominence, somewhat incurved over the narrow, concave, cardinal area. Brachial valve more convex than the pedicle, with a broad, low, ill-defined mesial fold toward the front. Surface of both valves marked by fine, radiating striæ.

The dimensions of a rather small pedicle valve are: length, 18 mm.; width, 21 mm.; convexity, 5.5 mm. Those of an average-sized brachial valve are: length, 22 mm.; width, 25 mm.; convexity, 7 mm.

Remarks.—This species is closely allied to *Schizophoria multistriata* H. of the higher Helderbergian beds, but may be distinguished from that species by its more or less conspicuous double sinus in the pedicle valve.

GYPIDULA GALEATA (Dal.).

Plate XXVIII., Figs. 1–8.

.859. *Pentamerus galeatus* Hall, Pal. N. Y., vol. III., p. 257, pl. 46, figs. 1 *a–z*, pl. 47, figs. 1 *a–m*.

Description.—Shell subglobose, becoming more and more elongate with age. Pedicle valve gibbous, becoming exceedingly ventricose in the umbonal region in old shells; longitudinally subovate in outline when mature, the younger shells often being transversely subelliptical in outline; the surface smooth in young indivduals, becoming plicated and developing a mesial fold with age; the beak prominent and strongly incurved. Internally the dental plates extend forward from the margins of the delthyrium, and are united to form a prominent spondylium, which is supported by a strong median septum. Brachial valve depressed-convex, usually transversely subelliptical in outline, but sometimes becoming longer than wide in old age. Surface smooth in young shells, and on the umbonal portion of adults, becoming plicated with age and developing a shallow, indefinite median sinus. Surface of both valves marked with low, rounded plications, which are more or less variable in number and in prominence, and which do not reach to the beak, leaving the umbonal region smooth. Toward the beak and upon the umbonal region the concentric lines of growth are usually inconspicuous or obsolete, but towards the anterior margin, in old shells, they become coarse and crowded.

The dimensions of an average-sized pedicle valve are: length, 27 mm.; width, 24 mm.; convexity, 14 mm. The dimensions of the largest pedicle valve observed are: length, 44 mm.; width, 31 mm.; convexity, 23 mm.

Remarks.—This shell, in its typical American form, is exceedingly abundant in the lower beds of the Coeymans limestone, and, except in characters due to different stages of growth, does not exhibit any great variation. Formerly the species was placed in the genus *Pentamerus,* and, because of its great abundance, the formation was designated the "Pentamerus limestone" in the older geological and paleontological reports of New York State. The species may always be recognized by its subglobular form and its smooth umbonal region. Frequently, in breaking the rock containing specimens of this shell, individuals are split longitudinally along the line of the median septum, and in such specimens the characteristic median septum can be clearly seen.

GYPIDULA GALEATA (Dal.) var.

Plate XXVIII., Figs. 9–12.

In the upper portion of the Coeymans limestone near Hainesville lateral slopes convex, rounding into the posterior region of the valve, sometimes bearing a single, subangular plication on each side adjacent to the mesial fold. Brachial valve transversely subelliptical in outline, much less convex than the opposite one, with a more or less abruptly-depressed median sinus near the anterior margin, which usually contains two well-defined, rounded or subangular plications. The surface of both valves, aside from the plications already described, is smooth, or marked only by inconspicuous lines of growth.

The dimensions of a large pedicle valve are: length, 21 mm.; width, 23.5 mm.; convexity, 11.5 mm. Those of a smaller brachial valve are: length, 13.5 mm.; width, 16.5 mm.; convexity, 4 mm.

Remarks.—This species has only been observed in the upper portion of the Coeymans limestone, associated with the variety of *G. galeata* last described. It differs from *G. galeata* in its much more prominent fold of the pedicle valve, which is extended further toward the beak, and in its much coarser and more conspicuous subangular plications, which are either restricted to the mesial fold and sinus, or to these portions of the shell and the immediately adjacent parts of the lateral slopes. These characters are constant in all the specimens observed, and they show no intermediate forms connecting them with *G. galeata*, and, as they also occur at a somewhat higher geologic horizon than the typical *galeata*, is believed that they are worthy of being distinguished as a separate species.

RHYNCHONELLA SEMIPLICATA (Con.).

Plate XXIX., Figs. 12–19.

1859. *Rhynchonella semiplicata* Hall, Pal. N. Y., vol. III., p. 224, pl. 29, figs. 1 *a–o*.

Description.—Shell small, subtriangular or suboval in outline. Pedicle valve with a closely-incurved beak, smooth on the umbo and to about the middle of the shell; plicated toward the margin, the mesial portion depressed toward the front in a rather deep sinus, usually with a single, short, median plication. Brachial valve a little more convex than the pedicle, smooth posteriorly, with an elevated mesial fold toward the front, and plications toward the margin. Both valves marked by two or three angular plications on each side of the fold and sinus, which do not extend beyond the middle of the shell, and usually by a single median plication in the fold and sinus. In the younger individuals, before the plications begin to be developed, the surface is entirely smooth.

The dimensions of a full-grown individual are: length, 5.5 mm.; width, 5.5 mm.; thickness, 3.5 mm.

Remarks.—This little species resembles younger individuals of *R. altiplicata*, but may always be distinguished by the smooth posterior portion of the shell, the plications ending at about the middle, while in *R. altiplicata* they reach nearly to the beak.

RHYNCHONELLA ALTIPLICATA Hall.

Plate XXIX., Figs. 24–27.

1859. *Rhynchonella altiplicata* Hall, Pal. N. Y., vol. III., p. 231, pl. 33, figs. 2 *a–k*.

Description.—Shell broader than long, subtriangular or broadly subovate in outline. Pedicle valve with a pointed, incurved beak, depressed anteriorly in a deep, angular sinus, which extends to the umbo and bears a single, strong, angular, median plication. Brachial valve more convex than the pedicle, elevated in front in an angular

RHYNCHONELLA TRANSVERSA Hall.

Plate XXIX., Figs. 28–31.

1859. *Rhynchonella transversa* Hall, Pal. N. Y., vol. III., p. 234, pl. 34, figs. 9–16.

Description.—Shell subtriangular in outline, wider than long, the postero-lateral margins meeting at the beak in an angle of 90° or a little more. Pedicle valve depressed-convex, most prominent on the umbo; depressed anteriorly in a rather broad, rounded sinus; the beak pointed, incurved over that of the opposite valve. Brachial valve more convex than the pedicle, flattened on the umbo, elevated anteriorly in a prominent mesial fold. Surface of each valve marked by about fifteen simple, angular plications, which extend to the beak, about three of them being included in the fold and sinus.

The dimensions of an average-sized individual are: length, 8 mm.; width, 10 mm.; thickness, 5.5 mm.

UNCINULUS MUTABILIS (Hall).

Plate XXIX., Figs. 1–5.

1859. *Rhynchonella mutabilis* Hall, Pal. N. Y., vol. III., p. 225, pl. 29, figs. 4 *a–o*, pl. 30, figs. 1 *a–e*, 2 *a–r*.

Description.—Shell subglobose, usually longer than wide. Pedicle valve strongly convex, most prominent on the umbo; beak small, pointed, closely incurved over that of the opposite valve, the anterior margin produced into a linguiform extension nearly at right angles to the plane of the valve and fitting into a corresponding sinus in the margin of the brachial valve. The mesial portion of the valve, opposite the lingual extension, slightly depressed anteriorly into a shallow, more or less inconspicuous mesial sinus. Brachial valve usually a little more convex than the opposite one, its beak closely incurved under that of the pedicle valve. Toward the front its mesial portion is slightly elevated in an indistinct, depressed fold. Surface of each valve marked by twenty-two to twenty-eight depressed, rounded, simple plications, which reach to the beak, about six or eight of them being included in the sinus and lingual extension of the pedicle valve, with a corresponding number on the fold of the brachial valve. Toward the front each plication is marked by a slight median groove.

The dimensions of a nearly perfect specimen are: length, 19 mm.; width, 17 mm.; thickness, 18 mm.

UNCINULUS NUCLEOLATUS (Hall).

Plate XXIX., Figs. 6–9.

1859. *Rhynchonella nucleolata* Hall, Pal. N. Y., vol. III., p. 227, pl. 31, figs. 1 *a–f*, 2 *a–y*.

Description.—Shell subglobular or subcubical in form, longer than wide, the anterior view subquadrangular. Pedicle valve suboval or subpentagonal in outline, flattened on the umbo, the lateral and front margins bending more or less abruptly to the line of junction of the two valves. The median portion of the valve depressed toward the front in a shallow sinus, which is produced anteriorly into a linguiform extension at nearly a right angle to the plane of the valve. Brachial valve more convex than the pedicle, its lateral margins

UNCINULUS PYRAMIDATUS (Hall).

Plate XXIX., Figs. 10–11.
See, also, p. 309.

1859. *Rhynchonella pyramidata* Hall, Pal. N. Y., vol. III., p. 229, pl. 32, figs. 1 *a–z*, 2 *a–d*.

Description.—Shell subglobular or subpyramidal in form, suboval or subpentagonal in outline, length and breadth equal or broader than long. Pedicle valve depressed-convex, more or less sharply deflected along the postero-lateral margins, the beak rather blunt, closely incurved over that of the opposite valve; the anterior margin produced in a lingual extension, which is bent at nearly right angles to the plane of the valve, the mesial sinus but slightly depressed. Brachial valve very gibbous toward the front, sloping with a gentle, convex curve from near the front margin to the beak; umbo flattened, incurved under that of the opposite valve. Surface of each valve marked by thirteen to eighteen simple, rounded plications, which are flattened or slightly grooved toward the front margin. Three or four plications are included in the sinus and lingual extension of the pedicle valve, with a corresponding number on the fold of the brachial valve. The plications of the pedicle valve become obsolescent upon the umbo and do not reach the beak; those of the brachial valve become much fainter, but do not wholly disappear on the umbo.

The dimensions of a nearly-perfect individual are: length, 16 mm.; width, 16 mm.; thickness, 16 mm.

Remarks.—This species is most closely related to *Unicinulus nucleolatus*, and it is quite possible that the two grade into one another. Typically *U. pyramidatus* has somewhat coarser plications, which are not so conspicuously grooved toward the front margin, and the brachial valve is much more elevated in front, giving it a subpyramidal form. In the Coeymans limestone the species does not grow so large as in the New Scotland beds. It has been found in this formation only in the higher beds near Hainesville.

RHYNCHOTRETA TRANSVERSA n. sp.

Plate XXIX., Figs. 32–39.

Description.—Shell small, broadly subtriangular, valves subequally convex, greatest width anterior to the middle, the postero-lateral slopes flattened, meeting at the beak in an angle of less than 90°. Pedicle valve depressed-convex, the beak slightly attenuate, sharply pointed, erect, the delthyrium broadly triangular, the median portion of the valve depressed anteriorly in a shallow sinus. Brachial valve depressed-convex, the median portion slightly elevated in front in an indefinite fold, the beak sharply incurved. The surface of each valve marked by from seven to nine simple, angular plications, which continue to the beak, one being included in the sinus of the pedicle valve and two elevated in the fold of the brachial valve.

The dimensions of a very perfect individual are: length, 5.5 mm.; width, 6.5 mm.; thickness, 2 mm. Those of another more mature specimen are: length, 6 mm.; width, 7.5 mm.; thickness, 3 mm.

Remarks.—In its sharply-pointed, erect beak, in the form of the delthyrium and in the flattened postero-lateral slopes, this little shell resembles *Rhynchotreta cuneata* of the Niagaran faunas, and the two shells are believed to be cogeneric. It differs from the Niagaran shell, however, in its smaller size and its greater proportionate breadth. The species is not uncommon in the higher beds of the Coeymans limestone near Hainesville, but has not been observed elsewhere.

dle, from which point it curves regularly to the margin on all sides. face of each valve marked by about forty bifurcating plications, ch are crossed by concentric lamellæ of growth.

he dimensions of a nearly perfect individual are: length, 25 mm.; th, 23 mm.; thickness, 17 mm.

emarks.—This is a variable form, the description given being le to fit the more usual form of the species as it occurs at this zon. The most conspicuous variations of the species are the tive convexity of the two valves, which are sometimes almost ally convex, and the number and size of the plications. The resentatives of the species in the Coeymans limestone, as well as he Helderbergian fauns generally, are usually more finely plicated n those of the Decker Ferry fauna.

SPIRIFER CYCLOPTERUS Hall.

Plate XXX., Fig. 2.
See, also, p. 314, pl. XXXVIII.

he genus *Spirifer* is usually not abundantly represented in the a of the Coeymans limestone, except at the very top of the ation, where several species occur. The commonest, and almost only member of the genus in the midst of the formation, is a shell h has been identified as *S. cyclopterus,* a species which, as inally described, is typically a member of the fauna of the New tland beds. The Coeymans limestone specimens in New Jersey all more or less fragmentary, and in none of the full-grown ones e surface perfectly enough preserved to retain the characteristic, entric and fimbriate markings of the species. A few small specis, which are apparently the young of this species, agree closely specimens of *S. vanuxemi* from the Manlius limestone, and at were so identified, and some of these retain the fine surface kings of the species. It is possible that *S. vanuxemi* is ancestral his Helderbergian species.

SPIRIFER MACROPLEURUS (Con.).

Plate XXX., Fig. 1.
See, also, p. 313, pl. XXXVII.

A single specimen referable to this species, belonging typically in the fauna of the New Scotland beds, has been observed in the Coeymans limestone associated with *Gypidula galeatus* and other typical members of the fauna. It is a pedicle valve, and is smaller than the usual size of the species in the higher fauna, it having a length of [illegible]9 mm. and a width of 28 mm.

SPIRIFER OCTOCOSTATUS Hall.

Plate XXX., Figs. 5–8.

1859. *Spirifer octocostatus* Hall, Pal. N. Y., vol. III., p. 205, pl. 2[illegible]8, figs. 4 *a–e*.

Description.—Shell wider than long, the hinge-line shorter than the greatest width, cardinal extremities rounded, anterior margin broadly rounded. Pedicle valve rather strongly convex, most elevated on the umbo, beak prominent, incurved over the short, ill-defined concave cardinal area, delthyrium broadly triangular, the median sinus smooth, continuing to the beak, subangular in the bottom. Brachial valve a

SPIRIFER CONCINNUS Hall.

Plate XXX., Fig. 3.

Spirifer concinnus Hall, Pal. N. Y., vol. III., p. 200, pl. 25, figs. 2 *a–i*, pl. 28, figs. 7 *a b*.

single imperfect brachial valve from the upper beds of the Coey- limestone near Hainesville is referable to this species. The -line is about equal to the greatest width of the shell, the lateral ins meeting the cardinal margin at about right angles. The l fold is prominent and rounded, continuing to the beak, without tions. Each lateral slope is marked by eight simple, rounded tions, which become fainter toward the cardinal margins, the wo or three being almost obliterated by reason of the exfoliated ition of the specimen.

e dimensions of the specimen are: length, 13 mm.; width, 18

CYRTINA sp. undet.

Plate XXX., Figs. 9–10.

the upper beds of the Coeymans limestone near Hainesville occurs a species of *Cyrtina* which seems to be different from nly described Helderbergian species, *C. dalmani* Hall. The rial is too imperfect for certain identification or for description. larger specimens of the pedicle valve have a very high, slightly- ve, cardinal area, with a broad delthyrium. The median sinus ther broad and shallow, and each lateral slope of the shell is ed by about three, broadly-rounded plications.

RHYNCHOSPIRA FORMOSA (Hall).

Plate XXXI., Figs. 9–11.
See, also, p. 240.

is species has already been described from the Decker Ferry ation, although it is typically a member of the Helderbergian s. The Coeymans limestone specimens are usually somewhat finely plicated than those in the Decker Ferry fauna, but they vary considerably in this character, a specimen occasionally being observed which has fully as coarse plications as the earlier ones. The species varies considerably in size, one of the larger specimens observed being 18 mm. long by 17 mm. wide, which is considerably larger than any which have been seen in the Decker Ferry fauna.

MERISTELLA LAEVIS (Van.).

Plate XXXI., Figs. 1–8.
See, also, p. 317.

The representatives of this species in the Coeymans limeston fauna of New Jersey are all small, it rarely attaining a length of mor than 10 mm. At the very summit of the formation near Hainesvill however, some larger individuals have been observed, one being 16. mm. in length and another 18 mm. They agree in all respects wit the younger individuals of the species as it occurs in some of th higher beds, being smooth, longitudinally subovate shells, with n sinus in the pedicle valve except in the case of the somewhat large individuals already mentioned from the top of the formation.

NUCLEOSPIRA VENTRICOSA Hall.

Plate XXX., Figs. 19–22.

MOLLUSCA.

PELECYPODA.

RHOMBOPTERIA CLATHRATUS n. sp.

Plate XXXI., Figs. 16–18.

Description.—Shell inequivalvate, oblique, subrhomboidal in outline, the anterior and posterior margins subparallel, the basal margin rounded. Hinge-line straight, produced anteriorly, as well as posteriorly from the beak, which is located anterior to the middle. Left valve strongly convex transversely across the umbonal ridge, scarcely auriculate in front, a shallow, indefinite sinus extending from the beak nearly vertically to the anterior margin. Surface marked by broad, concentric bands, which, on their lower margins and reaching for more than half their width, are crossed by two sets of fine striæ, making an angle with each other. The right valve associated with this shell, and doubtless belonging to it, is nearly flat, with rounded, concentric wrinkles, not marked by the cross-lines of the left valve.

A left valve somewhat larger than the average has a height, obliquely from the beak to the basal margin, of 22 mm.; its width, at right angles to this line, is 15 mm., and its convexity, 5 mm.

Remarks.—This species is rather common in the uppermost beds of the Coeymans limestone near Hainesville. The left valves are by far the most common, but very few specimens of the right valve, and all of these small, having been observed. Many of the specimens are entirely exfoliated, so that only the concentric bands can be recognized, the finer cross-lined surface markings being wholly obliterated. On the casts the anterior sulcus, extending vertically downward from the beak, is far more conspicuous than when the shell is preserved, and consequently, also, the anterior auriculation of the shell.

In general form and in surface markings this species resembles *Rhombopteria mira* Barr., from Bohemia, which has been made the type of the genus by Jackson,* but the anterior cardinal angle is more broadly rounded in the American shell and it is less auriculate anteriorly.

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* Mem. Bost. Soc. Nat. Hist., vol. IV., No. 8, p. 380.

RHOMBOPTERIA CLATHRATUS var.

Plate XXXI., Fig. 15.

In the Coeymans limestone near Peter's Valley a single specimen of *Rhombopteria* has been observed, which may represent a species distinct from the shell just described. The single imperfect specimen is not sufficient, however, to determine this with certainty, and it may for the present be considered as a variation of *R. clathratus*. Its contour is more irregular than that of the typical form of the species, the beak is more anterior and the anterior auriculation is more pronounced. The surface is, for the most part, exfoliated, but enough is retained to determine that its markings are essentially identical with *R. clathratus*.

ACTINOPTERIA COMMUNIS (Hall).

Plate XXXI., Fig. 21.

1859. *Avicula communis* Hall, Pal. N. Y., vol. III., p. 286, pl. 52, figs. 1–7, pl. 53, figs, 1, 4, 6.

Description.—"Shell obliquely ovate; the left valve gently convex in times not at all, perceptible on the posterior wing, except along its upper margin, while they are not seen on the anterior wing), concentrically marked by fine, lamellose striæ, which, in the more perfectly-preserved surfaces, are elevated and subimbricating; these striæ are usually conspicuous on both the anterior and posterior wings. Surface of the right valve marked by broader and scarcely elevated radii and less-defined concentric striæ."—*Hall.*

Remarks.—Fragments of a winged pelecypod shell are occasionally found in the Coeymans limestone, which are apparently to be identified with this species. No specimens perfect enough for description have been observed, so that the above description has been copied from the New York Paleontology.

CONOCARDIUM sp. undet.

Plate XXXI., Figs. 19–20.

Representatives of the genus *Conocardium* are rare in the Helderbergian faunas. A single specimen from the Coeymans limestone near Peter's Valley is too fragmentary for identification or description, but when complete it must have been a shell 15 mm. in height by 18 mm. in length. It is marked by flat ribs about equal in width to the flat-bottomed grooves which separate them.

GASTROPODA.

BULIMORPHA? HELDERBERGIAE n. sp.

Plate XXXII., Fig. 8.

Description.—Shell small, with five or six volutions, apical angle about 45°, the apex obtuse. Surface of the volutions depressed-convex, the suture shallow. Aperture subovate in outline, outer lip entire, columella lip smooth. Surface nearly smooth, with very fine lines of growth, which can only be detected with the aid of a lens.

The dimensions of a nearly-perfect specimen are: length, 7.5 mm.; diameter of last volution, 4.5 mm.; height of aperture, 4.5 mm.

Remarks.—This species from the upper beds of the Coeymans limestone near Hainesville resembles the little shells from the Carboniferous faunas, to which the name ***Bulimorpha*** has been applied by Whitfield.* So far as the specimens are preserved, they seem not to be generically distinct from Carboniferous specimens, and may be referred provisionally to that genus.

LOXONEMA? sp. undet.

Plate XXXII., Figs. 9–10.

Description.—Shell with a highly-elevated spire, apical angle about 21°, volutions eight or more in number, regularly convex, gradually expanding, the suture moderately deep. Aperture not well preserved, but apparently subcircular in outline. Surface nearly smooth, but with a magnifying glass exceedingly-fine lines of growth may be detected.

With the apex completed, the dimensions of a full-grown specimen are, approximately: length, 20 mm.; diameter of last whorl, 6.5 mm.

Remarks.—More or less fragmentary specimens of this little shell are rather common in the higher beds of the Coeymans limestone near Hainesville. In none of them is the apex of the spire preserved, so that the total length of the shell and the total number of volutions upper part of the last volution rounded, becoming angular and plicate below; aperture somewhat rounded; peristome sinuous. Surface marked by fine, undulating, transverse striæ, which are crossed by much finer, obscure or obsolete, longitudinal striæ."—*Hall.*

Remarks.—This type of gasteropod shell is not common in the Coeymans limestone fauna, most of the specimens observed being from the upper beds near Hainesville. Those which are well enough preserved for identification seem to agree most closely with Hall's figures and description of *P. gibbosum,* and are consequently so named.

TENTACULITES ELONGATUS Hall.

Plate XXXII., Fig. 4.
See, also, pp. 319 and 363.

Fragments of this species are occasionally present in the Coeymans limestone fauna. They are usually in the form of internal casts, but the surface of the shells may occasionally be observed. The casts have the appearance of being a series of truncated cones placed end to end, each one being slightly smaller than the preceeding one, and forming a series of annulations, of which the lower slope is perpendicular and the upper one very gradual. Externally the annulations are rounded, the entire outer surface of the shell being marked by fine, annular striæ.

ARTHROPODA.

TRILOBITA.

DALMANITES PLEUROPTYX (Green).

Plate XXXII., Fig. 1.

1859. *Dalmania pleuroptyx* Hall, Pal. N. Y., vol. III., p. 356, pl. 74, figs. 1–12, pl. 75, fig. 1.

Description.—"Pygidium triangular, transversely convex; the posterior extremity acute, attenuate; the axis a little depressed toward the lower extremity, which rises in strong relief above the border below. The axis is gradually attenuate, the width at the posterior extremity being about one-third as great as at the anterior extremity, which is about five-eighths as wide as the greatest width of the lateral lobe at its upper margin; its outline is curved and sometimes scarcely carinate, the latter feature more often seen in the casts. The number of articulations in the axis is seventeen; and on each of the lateral lobes are eleven to thirteen ribs, which are little wider than the furrows which separate them, the whole bending downwards toward the outer extremities and uniting in a thickened border. Each rib of the lateral lobe is marked by a longitudinal groove, parallel with the margin and a little nearer to the upper than the lower margin."—*Hall.*

The dimensions of a full-grown pygidium are, approximately: length, 53 mm.; breadth, 68 mm.

Remarks.—Only the pygidium of this species has been detected in the New Jersey collections, and the specimens observed are, in almost every case, mere fragments. There is no doubt, however, of the identity of these imperfect specimens with this rather common species of the New York Helderbergian fauna.

PROETUS PROTUBERANS Hall.

DESCRIPTIONS OF SPECIES IN THE NEW SCOTLAND-BECRAFT FAUNA.

COELENTERATA.

SPONGIAE.

HINDIA FIBROSA (Roemer).

Plate XXXIII., Figs. 1-2.

1883. *Hindia fibrosa* Hinde, Cat. Foss. Sponges Brit. Mus., p. 57, pl. 13, figs. 1-1 *b*.

1895. *Hindia fibrosa* Girty, 14th Ann. Rep. N. Y. State Geol. for 1894, p. 263.

Description.—"Sponges globular in form, with an even, rounded surface and without peduncle or any point of attachment. The specimens vary between 13 mm. and 38 mm. in diameter. As seen in section through the centre, the growth of the sponge commences with a small, foreign body or even loose tissue in the centre, from which extend minute, straight canals, about 0.3 mm. wide, in close proximity to each other, to the outer surface. The canals are circular or polygonal in section; their walls are formed by the spicular skeleton. The individual element of the skeleton appears to have a thickened, spherical centre, from which four to six short arms radiate in different directions, and by their attachment to the ends of adjoining spicular arms form a continuous, open, very regular mesh. The spicular arms or rays appear to be either smooth or tuberculated. No special surface-spicules have been preserved."—*Hinde.*

Remarks.—This sponge has been observed in New Jersey only in the lower, cherty limestone member of the New Scotland beds. In most cases the spicular mesh surrounding the radiating canals has been dissolved, leaving only the empty mould. Such specimens are always siliceous, and may be easily recognized by their globular form and their radiate, spicular structure, which may be seen when the specimens are broken. Occasionally, however, specimens are preserved in the peculiar condition described by Girty, in which the radiating canals appear to be entirely surrounded by double walls, between which is preserved an imperfect cast of the spicular framework. Such specimens show a strong resemblance to a small, globular, Favosite coral. According to Girty, the size of the species has a considerably-greater variation than that indicated by Hinde, the specimens he studied ranging from 6 mm. to 64 mm. in diameter. The New Jersey specimens are usually from 15 mm. to 20 mm. in diameter.

ANTHOZOA.

STREPTELASMA STRICTUM Hall.

Plate XXXIII., Figs. 3–4.

1887. *Streptelasma strictum* Hall, Pal. N. Y., vol. VI., p. 1, pl. 1, figs. 1–10.

Description.—"Corallum simple, conical, very gradually and regularly enlarging; straight or very slightly curved, except at the apex, which is sometimes more abruptly bent. Exterior marked with strong undulations of growth and numerous, fine, concentric striæ; external rays very prominent, from forty-five to fifty at a point where the diameter of the corallum is 15 mm., the increase in numbers taking place usually at three distinct points, but sometimes at only two.

ECHINODERMATA.

CRINOIDEA.

ICTHYOCRINUS MAGNARADIALIS n. sp.

Plate XXXIII., Fig. 5.

Description.—Caylx cup-shaped, truncated at the base, the sides flaring at an angle of about 58°. Underbasal plates not exposed. Basal plates large, sharply pointed above, the distal angles reaching nearly one-half the distance from the base to the tops of the radials. Radial plates large, pentagonal, about as broad as high, pointed below. A single costal, very much wider than high, follows the radial in each ray and supports two series of distichals above. Brachial plates not known above the second distichals. Anal and radianal plates absent.

The dimensions of the type specimen are: height of calyx to top of radials, 6 mm.; diameter of calyx at top of radials, 11 mm.; height of costals at their lateral extremities, 1 mm.; width of costals, 6 mm.

Remarks.—This species may be easily distinguished from all other heretofore-described species of the genus *Icthyocrinus* by its large basal and radial plates and the very short costals, it having more the aspect of members of the genus *Lecanocrinus,* but lacking the anal and radianal plates of that genus. This is the first recognition of a Helderbergian or Devonian species of the genus, it having previously been recognized only in the Niagaran faunas and in the much younger lower Mississippian faunas.

MOLLUSCOIDEA.

BRYOZOA.

In some localities the lower, cherty beds of the New Scotland formation contain an abundance of bryozoans, belonging to several genera and species, but their condition of preservation is not satisfactory for proper study.

BRACHIOPODA.

GLOSSINA SPATIOSA (Hall).?

Plate XXXIII., Fig. 6.

1859. *Lingula spatiosa* Hall, Pal. N. Y., vol. III., p. 158, pl. 9, figs. 10–10 *a*.

In the lower cherty limestone member of the New Scotland beds near Hainesville a single specimen of a rather large, linguloid shell has been observed, which may belong to this species. It is broadly triangular in form, resembling *G. spatiosa* more closely than any other described Helderbergian species, but beyond this it has no characters preserved which can be used for identification.

PHOLIDOPS OVATA Hall.

See, also, p. 226, pl. XX.

Occasional specimens of a small species of *Pholidops* may be detected in the strata of the New Scotland formation, especially upon marked by fine, irregularly bifurcating, raised, radiating striæ, and by strong, more or less irregular, concentric wrinkles, which curve outward on approaching the cardinal margin.

The dimensions of a large specimen are: length, 37 mm.; width, 46 mm.

Remarks.—This species occurs occasionally in the lower cherty limestone of the New Scotland beds, is of more common occurrence in the shaley members of the formation, but is most conspicuous in the Becraft limestone, where it occurs in great abundance. The species may always be recognized by its strong, concentric wrinkles, resembling, in this character, *Leptæna rhomboidalis,* with which species it may sometimes be confused when imperfectly preserved. *L. rhomboidalis,* however, is always strongly geniculate towards the front, the concentric wrinkles being confined to the posterior, flattened portion of the shell, while in *S. beckei* the depressed-convex form of the shell continues to the margin, as do the concentric markings. The crenulated hinge-line of *S. beckei* would also always distinguish the two species, but this is a character which is rarely preserved.

STROPHEODONTA sp. undet.

There are in the New Scotland beds and the Becraft limestone, and especially in the latter formation, more or less numerous specimens of *Stropheodonta,* which doubtless represent several species. They are all so poorly preserved, however, that their surface characters have been practically destroyed, and it is not possible to identify them. One or two forms are possibly undescribed species, but much better material must be had before their characters can be made out satisfactorily.

STROPHONELLA PUNCTULIFERA (Con.).

Plate XXXIII., Fig. 9.
See, also, p. 277.

This species has already been described from the Coeymans limestone. The New Scotland and Becraft limestone specimens are similar in all respects to those of the preceding fauna, and their state of preservation is much the same, all the specimens observed being fragmentary.

STROPHONELLA LEVENWORTHANA (Hall).

Plate XXXIV., Figs. 1-3.

1859. *Stropheodonta levenworthana* Hall, Pal. N. Y., vol. III., p. 189, pl. 21, figs. 5–7, pl. 23, figs. 1–2.

Description.—Shell longitudinally semi-elliptical, length greater than the breadth, hinge-line crenulated, equaling the greatest width of the shell. Pedicle valve depressed-convex on the umbo, flattened toward the cardinal margin, abruptly inflected toward the lateral and front margins, giving to the entire valve a deep concavity; beak inconspicuous, cardinal area linear. Brachial valve slightly concave in the umbonal region, strongly convex or geniculate toward the front and lateral margins, following somewhat closely the curvature of the opposite valve. Surface of both valves marked by fine, irregularly-bifurcating, raised, radiating striæ, which are crossed on the flattened portion of the valves by more or less irregular, concentric wrinkles.

The dimensions of a large specimen are: length, 36 mm.; width, 43 mm.; convexity of brachial valve, 15 mm.

Remarks.—This is one of the rarer species of the New Scotland fauna in New Jersey, and has been observed only in the lower cherty limestone member of the formation, where it is always in a poor con-

ORTHOTHETES WOOLWORTHANUS (Hall).

Plate XXXIV., Figs. 4–5.
See, also, p. 278, pl. XXVII.

This species, as it occurs in the New Scotland beds, differs in no respect from the Coeymans limestone specimens.

ORTHOSTROPHIA STROPHOMENOIDES (Hall).

Plate XXXIV., Figs. 6–8.

859. *Orthis strophomenoïdes* Hall, Pal. N. Y., vol. III., p. 177, pl. 14, figs. 2 *a–l*, pl. 23, figs. 7 *a–g*.

Description.—Shell subquadrate in outline, regularly rounded in front; hinge-line straight, a little shorter than the greatest width of the shell; cardinal angles obtusely angular. Pedicle valve depressed-convex on the umbo, flattened or slightly concave toward the lateral margins, with a narrow mesial elevation extending from the beak to the anterior margin, but becoming less sharply-defined anteriorly; beak small, but slightly elevated above the hinge-line; cardinal area narrow. Brachial valve much more convex than the pedicle, most prominent a little posterior to the middle, with a narrow and shallow mesial depression extending forward from the umbo, becoming broader and less sharply-defined anteriorly. Surface of both valves marked by fine, radiating plications, which increase by irregular bifurcation and intercalation. When the surface is not exfoliated, rather strong, concentric, lamellose lines of growth are present.

The dimensions of a nearly-perfect specimen are: length, 27 mm.; width, 31.5 mm.; thickness, 15 mm.

Remarks.—This species has been observed only in the shaley member of the New Scotland formation, and even there it is usually not a common species. The shell itself is frequently wholly destroyed, leaving the specimens in the form of casts of the interior, upon which the strong muscular impressions are a conspicuous character.

RHIPIDOMELLA OBLATA (Hall).

Plate XXXV., Figs. 9–13.
See, also, p. 350.

1859. *Orthis oblata* Hall, Pal N. Y., vol. III., p. 162, pl. 10, figs. 1–22.

Description.—Shell sublenticular in form, transversely subelliptical in outline when adult, the hinge-line a little less than one-half the total width. Pedicle valve convex at the beak and on the umbo, flattened in the middle and slightly concave toward the lateral and front margins; the beak pointed, produced but slightly beyond that of the brachial valve; cardinal area small, concave. Brachial valve convex, deeper than the pedicle valve, with a slight mesial flattening, extending from the beak to the front margin; the beak nearly even with that of the opposite valve. Surface marked by fine, raised, rounded striæ, which increase by frequent bifurcation, and are curved toward the lateral and cardinal margins. The striæ are crossed by finer concentric striæ and by stronger lines of growth, which become more numerous and crowded towards the margin of the older shells.

The dimensions of a nearly-perfect specimen of average adult size are: length, 28 mm.; width, 31 mm.; thickness, 12 mm.

Brachial valve convex in the middle, depressed toward the margins, the beak produced but slightly beyond the hinge-line. Surface of both valves marked by fine, raised, radiating, irregularly-bifurcating striæ, which are curved toward the cardinal margin; also by more or less conspicuous, concentric lines of growth.

The dimensions of an average specimen are: length, 27 mm.; width, 28 mm.

Remarks.—This species is associated with *R. oblata* and resembles it in some respects, but is much less frequent. It has a relatively longer hinge-line, with a much larger cardinal area, and consequently a more prominent beak on the pedicle valve. The length of the shell is also usually greater, as compared with its width.

DALMANELLA PERELEGANS (Hall).

Plate XXXV., Figs. 5–8.
See, also, p. 327.

1859. *Orthis perelegans* Hall, Pal. N. Y., vol. III., p. 171, pl. 13, figs. 4–12.

Description.—Shell transversely subelliptical in outline, the hinge-line about equal to one-half the greatest width. Pedicle valve strongly elevated along the median line from the beak towards the front, sloping laterally; the beak small, pointed, incurved over the narrow, concave, cardinal area, extending a little beyond that of the brachial valve. Brachial valve nearly or quite as convex as the pedicle valve, more or less flattened or depressed along the median line; beak small and but little produced beyond the hinge-line. Surface marked by fine, irregularly-bifurcating, radiating, raised striæ, which are often irregularly alternating, several smaller ones occupying the spaces between larger ones. These radiating markings are crossed by concentric lines of growth, of greater or less prominence.

The dimensions of a full-grown specimen of average size are: length, 24 mm.; width, 27 mm.; thickness, about 12 mm.

DALMANELLA SUBCARINATA (Hall).

Plate XXXIV., Figs. 10–13.
See, also, p. 326.

1859. *Orthis subcarinata*, Hall, Pal. N. Y., vol. III., p. 169, pl. 12, figs. 7–21.

Description.—Shell subplano-convex in form, subcircular, subquadrangular or transversely subelliptical in outline, the hinge-line one-half to two-thirds the greatest width. Pedicle valve strongly convex, subcarinate along the median line, sloping to the lateral margins; beak small, incurved over the narrow area. Brachial valve more or less flattened, with a distinct depression along the median line, which becomes wider anteriorly, producing a sinus in the front margin of the shell. Surface marked by fine, raised, equal or alternating striæ, which increase by irregular bifurcation and are curved towards the cardinal margin; marked, also, by finer, concentric striæ over the entire surface and by strong lines of growth toward the margin of adult shells.

The dimensions of an adult specimen of average size are: length, 17 mm.; width, 18 mm.; convexity of pedicle valve, 6 mm.

Remarks.—This shell resembles *D. perelegans*, and it is probable that the two species run together. In its typical form it differs from the last in being more nearly plano-convex and usually in being somewhat smaller.

broadly triangular. Brachial valve depressed-convex, flattened toward the cardinal extremities, the beak projecting nearly as far as that of the pedicle valve. Surface marked by more or less unequal, raised, radiating striæ, which increase by irregular bifurcation; marked, also, by much finer concentric striæ and by lines of growth which are most conspicuous near the front margin of adult shells.

The dimensions of a rather large adult shell are: length, 6 mm.; width, 7.5 mm.; thickness, 3.33 mm.

SCHIZOPHORIA MULTISTRIATA (Hall).

Plate XXXV., Figs. 1–4.

1859. *Orthis multistriata* Hall, Pal. N. Y., vol. III., p. 176, pl. 15, figs. 2 *a–t*.

Description.—Shell subcircular or transversely subelliptical in outline, hinge-line equaling about one-half the width of the shell. Pedicle valve convex, the greatest elevation posterior to the middle, a broad, shallow, ill-defined mesial sinus extending from the umbo to the front margin; beak projecting a little beyond that of the opposite valve, slightly incurved. Brachial valve more convex than the pedicle, gibbous posteriorly. Surface of both valves marked by fine, crowded, subequal, raised, radiating striæ, which increase by intercalation and by bifurcation, and are crossed by a few inconspicuous lines of growth.

The dimensions of an average specimen are: length, 20 mm.; width, 25 mm.

Remarks.—This species has been observed only in the Becraft limestone. It differs from *S. bisinuata,* from the Coeymans limestone, in the simple sinus of the pedicle valve, not having a double depression, as in that species. In other characters the two species are much alike.

SCENIDIUM INSIGNE (Hall).

Plate XXXVI., Figs. 1–4.

1859. *Orthis insignis* Hall, Pal. N. Y., vol. III., p. 173, pl. 13, figs. 13–16.

Description.—Shell minute, subpyramidal in form, greatest width along the hinge-line. Pedicle valve with an extremely-elevated, pointed, straight or slightly-incurved beak, cardinal area large, flat or slightly concave, delthyrium broadly triangular, mesial line slightly elevated in a low, narrow, rounded fold, from which the sides slope away to the cardinal and lateral margins. Brachial valve semi-circular, nearly flat, with a well-marked sinus along the mesial line. Surface of each valve marked by from five to seven flat, rounded plications on each side of the fold and sinus.

The dimensions of a full-grown specimen are, approximately: length, 2 mm.; width, 4 mm.; height of area on pedicle valve, 2 mm.

Remarks.—This minute species is occasionally detected upon the weathered surfaces of the cherty limestone at the base of the New Scotland beds.

UNCINULUS VELLICATUS (Hall).

Plate XXXVI., Figs. 5–7.

from five to eight plications are included in mesial sinus and a corresponding number on the fold of the brachial valve.

The dimensions of an average specimen are, approximately: length, 17 mm.; width, 19.5 mm.

Remarks.—This species may be distinguished from most of the other Rhynchonelloid shells in the Helderbergian faunas of New Jersey by its much finer plications. The only other species with as fine plications is *U. mutabilis,* from the Coeyman's limestone, but the subglobose form of that species will easily distinguish it from *U. vellicatus.* The species is usually poorly preserved in New Jersey, and occurs, for the most part, in the upper portion of the New Scotland beds or the Becraft limestone.

UNCINULUS PYRAMIDATUS (Hall).

Plate XXXVI., Figs. 8–11.
See, also, p. 285, pl. XXIX.

This shell attains a much larger size in the fauna of the New Scotland beds than in the Coeyman's limestone, and is also a much commoner species.

RHYNCHOTREMA FORMOSA (Hall).?

Plate XXXVI., Figs. 12–15.
See, also, p. 328.

1859. *Rhynchonella formosa* Hall, Pal. N. Y., vol. III., p. 236, pl. 35, figs. 6 *a–y.*

Description.—Shell subrhomboidal in outline, wider than long. Pedicle valve convex on the umbo, from which point the surface curves abruptly to the cardinal and gently to the lateral margins, depressed toward the front in a deep and sharply-defined mesial sinus, which is produced in front. Brachial valve more convex than the pedicle, greatest elevation at the anterior margin, with a prominent median fold beginning at the middle of the valve and continuing to the front. Surface of each valve marked by from sixteen to eighteen simple, angular, radiating plications, of which three occupy the mesial sinus of the pedicle valve and four the fold of the brachial valve.

The dimensions of a nearly-perfect specimen are: length, 9 mm.; width, 11.5 mm.; thickness, 7.5 mm.

Remarks.—Several specimens of this little shell have been observed in the upper portion of the New Scotland beds and in the Becraft limestone. They resemble the illustrations of *R. formosa* in the New York Paleontology, but are much smaller than the mature forms of that species, although they are evidently adult shells.

EATONIA MEDIALIS (Van.).

Plate XXXVI., Figs. 16–23.

1859. *Eatonia medialis* Hall, Pal. N. Y., vol. III., p. 241, pl. 37, figs. 1 *a–y*.

Description.—Shell transversely subelliptical, subcircular or subquadrate in outline. Pedicle valve depressed-convex on the umbo, flattened or concave toward the lateral margins, depressed in front in a deep mesial sinus, which is more or less produced into a lingual extension at nearly a right angle to the plane of the valve; the beak not prominent, incurved over that of the opposite valve. Internally the muscular impression of the pedicle valve is rather large, ovate, distinctly defined by a prominent border and marked by longitudinal, slightly-radiating plications; near its centre is the small, cordiform, longitudinally striated impression of the adductor muscle. Brachial valve strongly convex, with a more or less elevated mesial fold toward

EATONIA SINGULARIS (Van.).

Plate XXXVI., Figs. 24–27.

1859. *Eatonia singularis* Hall, Pal. N. Y., vol. III., p. 243, pl. 38, figs. 14–20.

Description.—Shell broader than long, varying from broadly subovate to subrhomboidal in outline, the postero-lateral margins meeting at the beak in an angle greater than 90°. Pedicle valve depressed-convex on the umbo, flattened or concave toward the lateral margins, depressed toward the front in a deep mesial sinus, which is produced in front in a lingual extension at nearly right angles to the plane of the valve; beak small, closely incurved over that of the opposite valve. Brachial valve strongly convex, with a conspicuous mesial fold toward the front; greatest elevation at the middle of the anterior margin. Surface marked by fine, radiating striæ, which, on well-preserved specimens, are crossed by much finer, concentric striæ. Usually a rather broad, flat, rounded ridge occupies the median line of the pedicle valve. Toward the front margin of full-grown shells there are several strong, closely-crowded, concentric lines of growth.

The dimensions of a nearly-perfect, full-grown individual are: length, 16 mm.; breadth, 17.5 mm.; thickness, 12.5 mm.

CENTRONELLA? SUBRHOMBOIDEA n. sp.

Plate XXXVII., Figs. 7–10.

Description.—Shell subrhomboidal in outline, longer than wide. Pedicle valve prominent along the median line, sloping away to the cardinal and lateral margins; the cardinal margins infolded and forming a sort of false cardinal area; beak sharply pointed and slightly incurved. Brachial valve depressed-convex, most prominent near the middle. Surface of both valves marked by fine, concentric lines of growth, which are slightly fasiculate at intervals. Shell substance apparently punctate.

The dimensions of the nearly-perfect type specimen are: length, 11 mm.; width, 9.5 mm.; thickness, 6 mm.

Remarks.—The internal characters of this species have not been observed, but it is apparently a member of the family *Centronellidæ,* although it may not belong to the genus *Centronella.* In some respects it resembles members of the genus *Oriskania,* especially in the general outline of the shell, the infolded cardinal margin of the pedicle valve and the pointed beak, and this species may be an early representative of that genus.

ATRYPINA IMBRICATA (Hall).

Plate XXXVII., Figs. 17–22.

1859. *Leptocœlia imbricata* Hall, Pal. N. Y., vol. III., p. 246, pl. 38, figs. 8–13.

Description.—Shell small, varying from subcircular to subrhomboidal and to longitudinally subsemi-elliptical in outline; hinge-line shorter than the greatest width, cardinal angles rounded. Pedicle valve convex, most prominent at about the middle, sloping to the lateral and cardinal margins; beak small, pointed, slightly incurved, perforated at its apex by the foramen. Brachial valve depressed-convex or nearly flat, its beak scarcely produced beyond the hinge-line. Surface of each valve marked by from six to twelve strong, rounded, radiating plications, of which some of the central ones sometimes divide in [redacted] larger specimens. On the pedicle valve the two central plications [redacted] than the others, the depression between [redacted] brachial valve there [redacted]

SPIRIFER MACROPLEURUS (Con.).

Plate XXXVII., Figs. 1-3.

1859. *Spirifer macropleurus* Hall, Pal. N. Y., vol. III., p. 202, pl. 27, figs. 1 *a–p*, pl. 28, figs. 8 *a–d.*

Description.—Shell large, varying from semi-circular to transversely subelliptical in outline; hinge-line varying from a little less than the greatest width to somewhat extended beyond the shell in front; cardinal extremities usually angular, varying from somewhat obtusely so, to acutely angular in specimens with an extended hinge-line. Pedicle valve strongly convex, the beak extended beyond that of the opposite valve, abruptly incurved over the rather large, concave area; the mesial sinus non-plicate, broad and deep; three broadly-rounded plications on each lateral slope. Brachial valve equally or a little less convex than the pedicle valve, with broad, prominent, rounded, non-plicate mesial fold; two broadly-rounded plications and sometimes a third smaller one on each side of the fold. The entire surface is marked by fine, crowded, radiating striæ, and by finer concentric striæ, which have usually been destroyed. The shells are also usually marked by several more or less prominent, concentric lines of growth.

The dimensions of a rather small pedicle valve are: length. 27 mm.; width, 36 mm.; convexity, 10 mm.

Remarks.—This is the largest species of Spirifer in the Helderbergian faunas, and has rarely been observed in New Jersey save in the shaley member of the New Scotland beds, where it usually occurs in the form of internal casts.

SPIRIFER PERLAMELLOSUS Hall.

Plate XXXVII., Figs. 4–6. Plate XXXVIII., Fig. 7.

1859. *Spirifer perlamellosus* Hall, Pal. N. Y., vol. III., p. 201, pl. 26, figs. 1 *a–t*, 2 *a–g*.

Description.—Shell subtrigonal to subsemi-circular in outline, greatest breadth usually along the hinge-line; cardinal extremities varying from rounded to mucronate. Pedicle valve strongly convex, umbo prominent, beak incurved over the rather wide and sharply-defined, concave, cardinal area, much extended beyond that of the opposite valve; mesial sinus deep, rounded in the bottom, reaching to the beak, extended in front. Brachial valve nearly or quite as convex as the pedicle valve, most prominent on the rounded mesial fold near the anterior margin. Surface of both valves marked by six to eight abruptly and strongly-elevated, subangular plications on each side of the fold and sinus; covered, also, by strong, imbricating, concentric lamellæ, which are abruptly arched in passing over the plications, giving to the entire surface an extremely rough appearance.

The dimensions of an average-sized specimen are: length, 22 mm.: width, 34 mm.; thickness, 15 mm.

Remarks.—This species is common in the lower portion of the New Scotlond beds. The New Jersey specimens differ in no particular from those which occur so abundantly in the same formation in New York State.

SPIRIFER CYCLOPTERUS Hall.

Plate XXXVIII., Figs. 1–6.

1859. *Spirifer cyclopterus* Hall, Pal. N. Y., vol. III., p. 199, pl. 25, figs. 1 *a–z*.

The dimensions of a specimen from the shaley member of the New Scotland beds are: length, 12 mm.; width, 19 mm.

Remarks.—This species is present in the Coeymans limestone fauna, but becomes much more abundant in the New Scotland fauna, attaining its greatest numerical prominence in the Becraft limestone. No specimens have been observed in New Jersey attaining the size of the larger examples illustrated in the New York Paleontology, but they possess all the characteristics of the species. In the hard, cherty limestones the delicate surface markings, both the concentric lamellæ and their fine, marginal fimbriations have been destroyed, but upon some of the shale specimens these markings have been very perfectly preserved.

TREMATOSPIRA MULTISTRIATA Hall.

Plate XXXVIII., Figs. 8–10.

1859. *Trematospira multistriata* Hall, Pal. N. Y., vol. III., p. 209, pl. 24, figs. 3 *a–t, pl.* 28 *A,* figs. 5 *a–f.*

Description.—Shell transversely subelliptical in outline, hinge-line about two-thirds the greatest width, cardinal angles rounded. Pedicle valve rather strongly convex, beak incurved over that of the opposite valve, cardinal area narrow; mesial sinus broad, rounded in the bottom, ill-defined, sometimes, but not always, becoming obsolete before reaching the beak. Brachial valve usually a little more convex than the pedicle, the mesial portion elevated in front in an ill-defined, rounded fold. Surface of both valves marked by strong, subangular, raised, radiating striæ, which bifurcate one or more times in passing from the beak to the front of the shell. These radiating markings are crossed by concentric lines of growth.

The dimensions of an average-sized specimen are: length, 15 mm.; width, 24 mm.

Remarks.—This species has been observed only in the shaley member of the New Scotland beds, where it often occurs in considerable abundance, but is usually very poorly preserved.

NUCLEOSPIRA VENTRICOSA Hall.

Plate XXXVII., Fig. 16.
See, also, p. 290, pl. XXX.

In the shaley New Scotland beds a few specimens of this species, all of them internal casts, have been found.

ANOPLOTHECA CONCAVA (Hall).

Plate XXXVII., Figs. 11–15.
See, also, p. 371.

1859. *Leptocœlia concava* Hall, Pal. N. Y., vol. III., p. 245, pl. 38, figs. 1–7.

Description.—Shell small, subcircular or subelliptical in outline, varying from wider than long to longer than wide; cardinal angles rounded. Pedicle valve convex, subcarinate along the median line, sloping to the lateral and cardinal margins; beak small, slightly incurved. Brachial valve flattened towards the lateral margins, with a broad, undefined, concave, mesial sinus, which is deeper in the middle of the valve than at the front margin. Surface of each valve marked by from fourteen to seventeen rather small, rounded plications, of which some of the central ones sometimes bifurcate; the median plication of the pedicle valve is somewhat smaller than those on either

MERISTELLA LAEVIS (Van.).

Plate XXXVIII., Figs. 11-18.

1859. *Merista lævis* Hall, Pal. N. Y., vol. III., p. 247, pl. 39, figs. 1–4.

Description.—Shell subovate in outline, a little longer than wide. Pedicle valve strongly convex, greatest prominence at about the middle, with a shallow mesial sinus toward the front; the beak prominent, incurved. Brachial valve less convex than the pedicle, strongly convex on the umbo, with an ill-defined mesial fold towards the front. Surface of both valves smooth or marked only by obscure, concentric lines and by a few stronger, concentric lines of growth.

The dimensions of a large specimen are: length, 28 mm.; width, 27 mm.; thickness, 18 mm.

Remarks.—This species attains its largest size in the Becraft limestone; its average size becoming less and less in the lower and lower beds, down to the Coeymans limestone. In the shaley member of the New Scotland beds the species is common, but the shells are almost universally crushed and distorted, so that they are usually proportionally broader, and resemble *M. arcuata.*

MOLLUSCA.

PELECYPODA.

CYPRICARDINIA SUBLAMELLOSA Hall.

1859. *Cypricardinia sublamellosa* Hall, Pal. N. Y., vol. III., p. 267, pl. 50, fig. 1.

A fragment of an elongate, pelecypod shell, marked by concentric wrinkles, may represent this species. It occurs in the lower cherty limestone member of the New Scotland beds near Hainesville.

ACTINOPTERIA sp. undet.

Fragments of winged pelecypod shells are frequently met with in both members of the New Scotland beds and in the Becraft limestone, but none of the specimens observed are sufficiently well preserved for specific identification, although all are doubtless members of the genus *Actinopteria.*

MYTILARCA? sp. undet.

Plate XXXIX., Fig. 4.

An imperfect specimen of a pelecypod shell resembling members of the Silurian genus *Mytilarca* occurs in the lower cherty limestone member of the New Scotland beds near Hainesville. It is altogether too imperfect for identification or description, but may be referred provisionally to this genus.

GASTROPODA.

STROPHOSTYLUS GEBHARDI (Con.).

Plate XXXIX., Figs. 1–3.

1859. *Platyceras gebhardi* Hall, Pal. N. Y., vol. III., p. 312, pl. 56.

LOXONEMA ATTENUATA Hall.

Plate XXXIX., Figs. 5-6.

Loxonema attenuata Hall, Pal. N. Y., vol. III., p. 296, pl. 54, fig. 8, pl. 67, fig. 3.

cription.—"Shell fusiform, somewhat rapidly attenuating above st volution, which is ventricose; aperture undetermined. Surnknown."—*Hall.*

narks.—Some fragmentary specimens which agree in every rewith this description and the accompanying illustration have bserved in the lower cherty limestone member of the New Scoteds, and may be so identified.

PTEROPODA.

TENTACULITES ELONGATUS Hall.

See, also, pp. 295 and 363.

is species of *Tentaculites* is occasionally present in the fauna of ew Scotland beds, although it is rare and has as yet been obl only in the shaley member of the formation. Here it occurs s more or less crushed, internal casts, and does not differ essenfrom similar specimens in other formations.

CEPHALOPODA.

ORTHOCERAS sp. undet.

eral indeterminable fragments of *Orthoceras* have been observed lower cherty limestone member of the New Scotland beds.

ARTHROPODA.

TRILOBITA.

LICHAS PUSTULOSUS Hall.

Plate XL., Figs. 1–2.

1859. *Lichas pustulosus* Hall, Pal. N. Y., vol. III., p. 366, pl. 7[illegible], figs. 9–12, pl. 78, figs. 1–7.

Description.—"Pygidium somewhat triangular, excluding the marginal extensions of the ribs. The axis is extremely prominent, occupying about one-third the entire length, rising at its posterior extremity into a rounded boss, from the centre of which proceed two strong spines, with a smaller one on each side, and two in front and behind in the line of the two central ones. Median lobe below the axis prominent and rising in the middle into a strong node, bearing a double spine, and thence sloping abruptly backwards, and deeply bifurcate at the extremity. Ribs broad, extending in broad, mucronate processes beyond the sinuosities, which divide them for about one-third of their entire length; the submedian groove extends to the extremities, which are always gently bent upwards. The inner fold of the marginal limb is extremely thickened and deeply striated."—*Hall.*

HOMALONOTUS VANUXEMI Hall.

Plate XXXIX., Figs. 7–8.
See, also, p. 338, pl. XLIV.

A single specimen of the pygidium of this trilobite has been recognized in the Becraft limestone. It is of about average size, having a length of 38 mm., and differs in no respect from the later representatives of the species. So far as has been observed in New Jersey, this is the earliest occurrence of the species, it being most abundantly represented in the limestone at the base of the Oriskany series.

PHACOPS LOGANI Hall.

Plate XL., Figs. 3–4.

1859. *Phacops logani* Hall, Pal. N. Y., vol. III., p. 353, pl. 73, figs. 15–25.

Description.—General form of the entire trilobite longtitudinally elliptical. Head subcrescentiform, somewhat pointed in front, the genal angles rounded. Glabella large, subpentagonal in outline, broader than long, prominent and protuberant in front, bounded laterally by deep and narrow dorsal furrows, which converge posteriorly; upper surface convex. The two anterior pairs of lateral furrows very faint, extending obliquely forward from the margins of the glabella; the third pair strongly defined and continuing across the posterior portion of the glabella, cutting off a well-defined posterior segment, at each extremity of which is a prominent, subovate tubercle. Cheeks comparatively small, not extending forward beyond about the mdidle of the glabella, but more conspicuous posteriorly, where they are bordered by a smooth, convex margin. Eyes rather large, their summits less elevated than the glabella, containing seventeen vertical rows of lenses, full-grown individuals having about one hundred lenses altogether in each eye. Occipital furrow strongly defined on the axis, produced upon the cheeks, terminating within the marginal border. Occipital segment convex, rather broad and prominent. Surface of the glabella pustulose, and on perfectly-preserved specimens the occipital segment bears one median tubercle, with several smaller ones on each side.

Pygidium semi-circular in outline, with a prominent axis, bearing about nine annulations; the pluræ each have about five or six segments grooved along their median line.

The dimensions of an average adult head are: length, 13 mm.; width, 22 mm.

Remarks.—Fragments of this species are not uncommon, especially in the more calcareous beds of the New Scotland formation and in the Becraft limestone.

DALMANITES PLEUROPTYX (Green).

Plate XXXIX., Figs. 9–10.
See, also, p. 295, pl. XXXII.

The fragmentary remains of this species are somewhat more common in the New Scotland beds, especially in the lower cherty limestone member, than in the Coeymans limestone. Fragments of both the head and the pygidia have been observed, but their condition of preservation is always very poor.

DESCRIPTION OF SPECIES IN THE LOWER ORISKANY OR DALMANITES DENTATUS FAUNA.

MOLLUSCOIDEA.

BRYOZOA.

growth, and sometimes by numerous fine, concentric striæ and ob-
re, longitudinal striations. Interior smooth."—*Hall and Simpson.*
emarks.—This species has been observed in New Jersey only in the
lmanites dentatus fauna, where fragmentary specimens are not un-
nmon. The genus *Vermipora* was originally described by Hall[*]
a bryozoan, *V. serpuloides* being the type species, but in Volume VI.
the New York Paleontology it is apparently considered as a coral,
re or less closely allied to *Aulopora.* Girty,[†] however, has pointed
t that the manner of budding in *Vermipora* is fundamentally dif-
ent from *Aulopora,* and he places the genus with the *Bryozoa,* in
se proximity to *Hederella.*

BRACHIOPODA.

SCHIZOCRANIA SUPERINCRETA Barrett.

Plate XLI., Fig. 4.

8. *Trematis* (*Schizocrania*) *superincreta* Barrett, Ann. N. Y.
Acad. Sci., vol. I., p. 122.

Description.—Shell subcircular in outline, attached by the pedicle
ve to some external object. Brachial valve depressed-convex,
eatest convexity posterior to the middle; beak obtuse, marginal.
rface covered by fine, radiating lines, which, in the specimen ex-
ined, reach only about half way to the beak, those near the pos-
ior margin being curved. The radiating markings are crossed by
e, concentric lines of growth.

The dimensions of the only specimen observed are: length, 17
n.; width, 17 mm.; convexity, 2 mm.

Remarks.—A single specimen of this species, from the "trilobite
l" at Peter's Valley, has been observed, it being attached to the
chial valve of a species of *Stropheodonta.* The species was or-
ally described from the same bed near the New York State line.
the original description the radiating lines are said to continue
he beak, which is not the case in the specimen studied, although
absence of markings toward the beak may be due to the eroded

Twenty-sixth Rep. N. Y. St. Mus. Nat. Hist., p. 109.

Fourteenth Am. Rep. N. Y. St. Geol. for 1894, p. 307.

condition of the shell. Although the pedicle valve of the species has never been observed, there is little doubt of its being cogeneric with *S. filosa,* the type of the genus *Schizocrania,* which it resembles more or less closely.

ORBICULOIDEA AMPLA (Hall).

Plate XLI., Figs. 2–3.

1859. *Discina grandis* Hall, Pal. N. Y., vol. III., p. 406, pl. 92, figs. 1 *a–d.*

Description.—Shell broadly suboval in outline. Brachial valve depressed-subconical, apex subcentral, slightly inclined posteriorly, the surface slightly concave from the apex to the posterior margin, becoming slightly convex laterally and anteriorly. Surface marked by strong, sublamellose, concentric lines of growth, about 0.5 mm. apart. Pedicle valve not seen.

The dimensions of a nearly-perfect brachial valve are: length, 29 mm.; width, 27 mm.; convexity, 9 mm.

Remarks.—This species may be easily recognized by its large size and its conspicuous concentric markings. It was originally described from the Oriskany sandstone of New York.

LINGULA? sp. undet.

STROPHEODONTA sp. undet.

Plate XLI., Figs. 7–8.

Associated with the specimens identified as *S. magnifica* there are others representing another species, which are apparently members of the genus *Stropheodonta,* although the crenulated hinge has not been observed. They are all imperfectly preserved, and cannot be identified with any degree of certainty with any of the described species of the genus. The shell is much more strongly concavo-convex than *S. magnifica,* the convexity of one pedicle valve, 30 mm. in length, amounting to 8 mm. The radiating markings are also different, the costæ being sharper and more or less alternating in size. The specimens, especially the larger ones, are usually considerably wider than long, one external impression of the concave brachial valve being 34 mm. long by 48 mm. wide. It is possible that these specimens represent an undescribed species, but the material available for study is too unsatisfactory to warrant the establishment of a new species.

LEPTAENA RHOMBOIDALIS (Wilck.).

Plate XLI., Fig. 10.
See, also, pp. 228, 278, 302, 366.

This is not a common species in the fauna, but the specimens observed do not essentially differ from those in the earlier Helderbergian faunas.

ANOPLIA NUCLEATA Hall.

Plate XLI., Fig. 9.
See, also, p. 349, pl. XLVI.

Specimens of this species from the "trilobite bed" are not different from those in the overlying beds, except in usually being of somewhat smaller size.

CHONOSTROPHIA JERVENSIS Schuchert.

Plate XLII., Figs. 1–2.

1901. *Chonostrophia jervensis* Schuchert, Am. Geol., vol. XXVII., p. 250, figs. *c–d*.

Description.—Shell subsemi-circular or subsemi-elliptical in outline, hinge-line straight, usually equaling the greatest width of the shell. Cardinal extremities usually nearly rectangular, the lateral margins subparallel for a short distance, then curving into the broadly-rounded anterior margin. Pedicle valve slightly concave, cardinal margin straight, bearing on each side of the beak three or four spines directed obliquely outward, of which the outer ones are the larger, the others becoming regularly reduced in size; cardinal area flat, narrow. Brachial valve depressed-convex, flattened toward the cardinal extremities. Surface of both valves marked by fine, subequal, subangular, often somewhat wavy, radiating costæ, which increase by intercalation, about four occupying the space of 1 mm. at the margin. These radiating markings are crossed by much finer concentric markings.

The dimensions of an average specimen are: length, 9.5 mm.; width, 15 mm.

Remarks.—This species is exceedingly abundant in the *Dalmanites dentatus* fauna, some layers or lenticular masses being constituted very largely of these shells. It is easily distinguishable from the com-median line, lateral slopes nearly straight; beak rather small, incurved over the narrow cardinal area. Brachial valve depressed-convex on the umbo, flattened laterally, depressed medially in a shallow, ill-defined sinus, which broadens rapidly toward the front. Surface of both valves marked by numerous, fine, angular, radiating costæ, which increase by bifurcation and which become more and more strongly curved as they approach the cardinal margins. The radiating markings are crossed by much finer concentric striæ, which have usually been entirely obliterated on the New Jersey specimens.

The dimensions of a pedicle valve are: length, 15 mm.; width, 17 mm.; convexity, 5 mm.

Remarks.—This species is closely allied to *R. perelegans,* but is a smaller shell, with the brachial valve much more flattened and the pedicle valve more sharply carinate.

DALMANELLA PERELEGANS (Hall).

See, also, p. 305, pl. XXXV.

A few specimens in the "trilobite bed" seem to represent this species, which is more abundant in some of the older beds. They are associated with *D. subcarinata,* which is much the commoner form, but differ from members of that species in their larger size and less sharply-carinate pedicle valve. The only specimens observed are fragmentary, and do not at all perfectly represent the species.

RHYNCHONELLA BIALVEATA Hall.

Plate XLII., Figs. 9–10.

1859. *Rhynchonella? bialveata* Hall, Pal. N. Y., vol. III., p. 233, pl. 34, figs. 1–4.

Description.—Shell small, elongate, subtrigonal or subovate in outline; postero-lateral margins converging toward the beak at an angle of 55° to 65°. Pedicle valve moderately convex; surface rather abruptly curved to the postero-lateral margins, the median portion depressed anteriorly in an ill-defined, shallow sinus, which reaches only to about the middle of the valve; beak acute, erect. Brachial valve about equally convex with the pedicle, flattened in the centre, the lateral slopes curving rather abruptly to the postero-lateral margins; slightly depressed along the median line near the beak, but elevated toward the front in an ill-defined mesial fold scarcely higher than the general surface. Surface of each valve marked by twelve or thirteen angular, radiating plications. On the pedicle valve the median plication bifurcates near the beak, and near the centre of the valve an additional plication is intercalated between these two divisions. On the brachial valve the median plication bifurcates near the centre of the valve. The remaining plications on both valves are simple and continue to the beak.

The dimensions of an average specimen are: length, 6 mm.; width, 5 mm.; thickness, 3 mm.

Remarks.—The specimens which have been identified as *R. bialveata* agree closely with Hall's original description and illustrations of the species in general form, size and proportions, but the peculiar bifurcations of the central plications of each valve of the New Jersey shell is not as described by Hall. The number of New Jersey specimens available for study is small, and it is quite probable that with a larger number of specimens this character would be found to be more or less variable.

RHYNCHOTREMA FORMOSA (Hall).

Plate XLII., Figs. 5–8.

in front. Each valve marked by twenty to twenty-four simple, angular, radiating plications, three or four of which usually occupy the fold and sinus.

The dimensions of a nearly-perfect individual are: length, 16 mm.; width, 14 mm.; thickness, 9 mm.

RENSSELAERIA SUBGLOBOSUS n. sp.

Plate XLII., Figs. 11–18.

Description.—Shell subglobular in form, longer than wide. Pedicle valve strongly-convex, its greatest elevation near the middle, sometimes slightly subcarinate along the median line near the beak. Beak sharply-pointed, closely incurved over that of the opposite valve. Brachial valve a little less convex than the pedicle, its greatest elevation near the middle. Surface of each valve marked by from fifty to sixty simple, rounded plications, which become obsolete before reaching the beak.

The dimensions of an average specimen are: length, 18 mm.; width, 16 mm.; thickness, 11.5 mm.

Remarks.—This species is one of the very abundant ones in the "trilobite bed." It resembles *R. æquiradiatus,* but never attains the size of that species, the largest specimen observed out of several hundred examined, being 21 mm. in length, while adult individuals of *R. æquiradiatus* are 30 to 35 mm. in length. *R. subglobose* is also proportionally wider than *R. æquiradiatus.* The species also resembles *R. mutabilis,* but grows larger than that shell, is smoother, not being so conspicuously marked by concentric wrinkles of growth, and bears a greater number of plications.

SPIRIFER MURCHISONI Castel.

Plate XLII., Fig. 26.
See, also, p. 354, pl. XLVIII.

A few specimens of this Oriskany species have been observed. They do not differ essentially from those in the higher beds except in not reaching the maximum size of the later shells.

SPIRIFER NEARPASSI n. sp.

Plate XLII., Figs. 19–22.

Description.—Shell very small, wider than long; the hinge-line shorter than the greatest width, cardinal extremities rounded. Pedicle valve subpyramidal, the beak elevated, incurved, the surface sloping abruptly from the umbo to the lateral and anterior margins, lateral slopes curving rather abruptly into the cardinal area along the cardinal margin; mesial sinus shallow, but well-defined, extending to the beak; cardinal area high, concave, not sharply-defined. Brachial valve depressed-convex, the mesial fold not elevated above the plications on either side. Surface of each valve marked by about two strong, rounded plications on each side of the fold and sinus, the fold and sinus being scarcely more prominent than the plications on either side.

The dimensions of a perfect specimen are: length, 3 mm.; width, 4 1-3 mm.; thickness, 3 mm.

Remarks.—Unless this be an immature form it is quite distinct from any of the Helderbergian or Oriskany species of the genus. It is believed to be an adult shell, however, because all the specimens observed are of about the same size, and no larger shells have been seen associated with them, of which they could be the young. The species may be recognized by its small size, its subpyramidal pedicle valve and its few plications.

twisted; cardinal area high, flat, slightly concave or convex; delthyrium narrowly triangular, closed below by deltidial plates. Brachial valve depressed-convex, flattened toward the cardinal angles; mesial fold sharply defined, low, flattened on top with a slight, longitudinal mesial depression. Surface of each valve marked by from five to nine simple, subangular, radiating plications on each side of the fold and sinus, by finer concentric striæ and a few stronger lines of growth.

The dimensions of a nearly-perfect, but rather small, specimen are: length, 9 mm.; width, 15 mm.; thickness, 11 mm. The approximate dimensions of a larger brachial valve are: length, 13 mm.; width, 30 mm.

Remarks.—Fragmentary specimens of this species are common in the fauna of the "trilobite bed," but complete shells are rare. The species differs from *C. varia* Clarke of the higher beds in being larger and coarser in its general characters, in the more twisted or distorted beak of the pedicle valve and in the more nearly-flat cardinal area.

MERISTELLA PRINCEPS Hall.

Plate XLII., Figs. 27–28.

1858. *Merista princeps* Hall, Pal. N. Y., vol. III., p. 251, pl. 44, figs. 1–5.

Description.—Shell large, subovate in outline; the postero-lateral margins converging toward the beak in an angle of about 60°. Pedicle valve convex, the greatest convexity posterior to the middle; the lateral slopes curving rather sharply to the cardinal margins, depressed medially in the anterior half of the valve in a deep and more or less subangular sinus; beak prominent, incurved. Brachial valve strongly convex, much elevated along the median line towards the front; the lateral slopes curving rather strongly to the margins. Surface nearly smooth or marked by obscure, radiating and concentric striæ, with a few more conspicuous lines of growth most prominent towards the margin.

The dimensions of a large brachial valve are: length, 36 mm.; width, 35 mm.; convexity, 14 mm.

Remarks.—This species is rarely represented in the "trilobite bed" in the Nearpass section, but is a little more common farther south.

The specimens observed are all more or less fragmentary and imperfect, and the description given above has been drawn up largely from New York specimens. The species is especially characterized by the large size which it attains.

MOLLUSCA.

PELECYPODA.

ACTINOPTERIA TEXTILIS (Hall).

Plate XLIII., Figs. 13–14.

1859. *Avicula textilis* Hall, Pal. N. Y., vol. III., p. 288, pl. 52, figs. 9–10, pl. 53, figs. 2, 3, 5, 7, 10.

Description.—Body of shell obliquely subovate, anterior wing small, convex; posterior wing large, produced along the hinge-line, flat posteriorly, becoming convex towards the beak. Hinge-line longer than the vertical height of the shell, the beak situated near its anterior extremity. Surface of left valve marked by strong, sharply-elevated, more or less alternating radiating ribs, much narrower than the intervening depressions, and by fainter concentric lines, which

MEGAMBONIA PARVA n. sp.

Plate XLIII., Fig. 12.

Description.—Shell small, oblique; hinge-line straight, about hree-fourths the total length of the shell; both cardinal extremities ounded. Posterior, basal and lower portion of the anterior margin egularly rounded; a little below the middle the anterior margin is inuate and above the sinus it is convexly-curved to the anterior exremity of the hinge-line. Left valve strongly convex, the beak rominent and projecting beyond the hinge-line, situated at about he anterior third of the shell. Posterior umbonal slope concave, the osterior wing not sharply separated from the body of the shell. nterior wing convex, separated from the body of the shell by a ounded sinus, which extends towards the beak from the sinuosity in he anterior margin; in front of this sinus is a rounded fold, the nterior slope of which is slightly concave. Surface marked by ine, radiating costæ, about four or five in the space of 1 mm., which n the body of the shell are flat-topped and broader than the interening furrows, and bear two or three very fine longitudinal striæ. n the wings the radiating costæ are narrower and sharper, being much narrower than the intervening furrows. The radiating markings are crossed by finer concentric lines, which are inconspicuous upon the body of the shell, but which become sublamellose between the costæ upon the wings, more especially upon the posterior wing. Toward the beak the surface markings resemble those of the posterior wing rather than those of the body of the shell below.

The dimensions of a nearly-perfect left valve are: length, 10.5 mm.; height, 10 mm.; convexity, 5 mm.

Remarks.—This shell resembles *M. crenistriata* Clarke, from the Oriskany beds of Becraft mountain, but is smaller, with a straighter hinge-line and with quite different surface markings.

MEGAMBONIA? sp. undet.

A single fragmentary specimen of a pelecypod shell resembles somewhat the illustrations of *M. lamellosa* Hall, except in being a diminuive shell, the total length of the specimen not having been more than 14 mm. The specimen may represent a new species, but is altogether too imperfect for description. The only surface markings to be detected are concentric lines of growth.

GONIOPHORA ? sp. undet.

A single fragment which seems to be a portion of a small pelecypod shell of the genus *Goniophora* has been observed in the fauna of the "trilobite bed." Even the generic identification, however, is subject to much uncertainty.

GASTROPODA.

PLATYOSTOMA NEARPASSI n. sp.

Plate XLIII., Figs. 1–4.

Description.—Shell more or less subglobular in form, consisting of three or four volutions. Spire low, but little elevated above the outer volution; suture becoming deeply and abruptly impressed as it approaches the aperture. Aperture slightly oblique, subcircular in outline, its margin entire, inner lip free below, leaving a narrow, deep umbilicus. Surface marked by fine, regular, crowded lines of growth, which are sharply raised from the general surface of the shell.

The dimensions of an average specimen are: maximum diameter, 10 mm.; height, 7 mm. The largest specimen observed has a maxi-

PLATYCERAS sp. undet.

Plate XLIII., Figs. 5–7.

At least two different species of Capulid shells which may be referred to the genus *Platyceras* occur in the fauna of the "trilobite bed," but they are represented by such a limited number of specimens, all of which are imperfect, that it is not possible to identify them with certainty. The larger species consists of about one volution, which expands with great rapidity, so that the maximum diameter of the aperture of the largest and most perfect specimen examined is about 26 mm., while the depth of the shell, measured from the plane of the aperture, is only about 10 mm.

The second species is a shell consisting of about two and a half closely-coiled, gradually-expanding volutions, the outer one of which is subangular along the periphery. The spire is not elevated above the outer volution, and the shell has the aspect of members of the genus *Platyostoma,* and it is possible that it should be referred to that genus rather than to *Platyceras.* The maximum diameter of the only specimen of this shell which has come under observation is 9.5 mm., the height of its aperture being 5 mm.

LOXONEMA JERSEYENSIS n. sp.

Plate XLIII., Figs. 8–10.

Description.—Shell with an elevated spire, consisting of as many as fourteen volutions in the larger specimens. Apical angle, 23° to 26°. Volutions regularly convex, the sutures moderately impressed. Aperture subovate, higher than wide, the outer lip broadly sinuate, the greatest depth of the sinus being above the middle of the whorl. Surface marked by fine, transverse lines of growth, which follow the outline of the margin of the aperture.

The dimensions of a large individual with the apical portion destroyed are: maximum diameter, 11.5; total length with apex restored, 34 mm.

Remarks.—This is a common species of the "trilobite bed" in the Nearpass section and is apparently distinct from any of the described species of the genus.

PTEROPODA.

HYOLITHES CENTENNIALIS Barrett.

Plate XLIII., Fig. 15.

1877. *Hyolithes centennialis* Barrett, Ann. Lyc. Nat. Hist. N. Y., vol. XI., p. 299.

1888. *Hyolithes centennialis* Hall, Pal. N. Y., vol. V., pt. II., Supp., p. 6, pl. 114, figs. 21–23 (Supp. to Pal. N. Y., vol. VII.)

Description.—Shell subtrigonal or nearly semi-circular in cross-section, tapering gradually backward from the aperture to the obtusely-rounded posterior extremity, the sides converging a little more rapidly towards the posterior end. Ventral side slightly convex, lateral edges narrowly rounded, dorsal side strongly convex, more or less angular along the median line. Surface covered with fine, somewhat irregular, crowded, transverse lines of growth.

The dimensions of a specimen incomplete posteriorly are: length,

ıncated cones arranged one above the other, and are not
:asts of *T. elongatus* which occur in both earlier Helder-
nas and in the Oriskany, but the specimens are smaller
)ical *T. elongatus,* the largest specimen observed having a
liameter of 2 mm.

tes acula was originally described from the "Lower Hel-
oup, Port Jervis, Orange county," but the particular
m which the specimens were secured is not mentioned.
probably came from the "trilobite bed," however, as all
ecies which have been described as coming from the
an series of Port Jervis are, so far as can be determined,
ed. The larger specimens which have come under obser-
much larger than those which Hall described, although
iduals may be found of the size of that figured by Hall.
specimens agree with Hall's brief description in having
idistant annuli, but the few annular striæ on the intervals
letected on the casts. In the larger individuals the an-
ecome somewhat more irregular.

CEPHALOPODA.

ORTHOCERAS sp. undetermined.

Plate XLIII., Figs. 16–17.

Cephalopods detected in the "trilobite fauna" are frag-
e or two species of *Orthoceras* too imperfect for identifi-
e largest specimen observed (fig. 16) is a shell 22 mm.
, with sutures about 4 mm. apart. The septa are rather
ıve and the sipuncle is situated centrally. The shell
)lly destroyed, so that the nature of the surface-markings
letermined. Another smaller specimen is apparently a
the chamber of habitation of an *Orthoceras,* as no sutures
It has a diameter of about 8 mm. and seems to be marked
ısverse lines of growth.

ARTHROPODA.

TRILOBITA.

HOMALONOTUS VANUXEMI Hall.

Plate XLIV., Figs. 4–7.

1859. *Homalonotus vanuxemi* Hall, Pal. N. Y., vol. III., p. 352, pl. 73, figs. 9–14.

1888. *Homalonotus vanuxemi* Hall and Clarke, Pal. N. Y., vol. VII., p. 11, pl. 5 *B*, figs. 1–2.

Description.—Cranidium subtrigonal in outline, truncated anteriorly. Glabella depressed-convex, bounded by an ill-defined dorsal furrow, subquadrangular in outline, narrower in front; lateral lobes and furrows obsolete; occipital furrow well-defined, produced laterally upon the fixed cheeks; occipital segment rather narrow, flat. Anterior margin of the cranidium produced into a rather broad and flat border in front of the glabella. Fixed cheeks moderately convex, eye-lobes not conspicuous. Free cheeks subtriangular, longer than broad, with an ill-defined marginal border. Entire surface of the cephalic test, so far as observed, minutely pitted or punctate.

Pygidium subtriangular in outline, the lateral margins meeting [redacted] mentary condition. Fragments of the pygidia and thoracic segments occur abundantly, but the heads are less common. The species has also been observed in the Becraft limestone fauna, and specimens from this lower horizon are indistinguishable from those in the trilobite bed. The most perfect specimen of the head of this species which has been observed is not so greatly produced anteriorly as is indicated in the restoration of the head of the species given by Hall and Clarke.

DALMANITES DENTATUS Barrett.

Plate XLIV., Figs. 1–3.

1876. *Dalmanites dentata* Barrett, Am. Jour. Sci. (3), vol. II., p. 200, plate.

1888. *Dalmanites* (*Corycephalus*) *dentatus* Hall and Clarke, Pal. N. Y., vol. VII., p. 58, pl. 11 *A*, figs. 4–6.

Description.—Head subcrescentiform, the lateral and anterior margins forming a parabolic curve, the genal angles extended into rather blunt spines. Glabella depressed-convex, broadest in front, surrounded by a well-defined dorsal furrow, frontal lobe broader than long, subelliptical to subrhomboidal in outline. First pair of lateral furrows broad and deep, extending obliquely backward from the dorsal furrow and connected across the median portion of the glabella by a shallow depression. First and second lateral lobes partially coalescent externally by the shallowing of the second lateral furrows, the third pair of lateral lobes entirely separate from the second. Second and third pairs of lateral furrows indistinctly continuous across the median portion of the glabella by slight depressions. Occipital furrow sharply defined, continuous across the glabella and extending out upon the cheeks. Occipital segment of about the same width, but a little higher than the posterior lateral lobes. Cheeks convex in general contour, with a slightly-thickened marginal border. Eyes large, subcrescentiform, their summits as high or higher than the glabella, their anterior extremities opposite the first and their posterior extremities opposite the third lateral furrows of the glabella, bounded externally around the base of the faceted surface by a sharp depression, beyond which is a subangular ridge. Between this ridge and the slightly-thickened cheek margin the surface is concave. The entire lateral and anterior margin of the head is ornamented with a continuous series of from twenty-five to thirty-five triangular, tooth-like processes, largest in front and decreasing regularly in size to the genal angles. The surface of the glabella and those portions of the cheeks lying between the eyes and the glabella, except in the furrows, is covered with rather coarse, irregularly-arranged, circular tubercles, the outer portions of the cheeks, including the marginal denticles, being finely papillose. Thorax consisting of eleven segments, the axis a little less than one-third the entire width, pluræ extended into sharp, posteriorly-pointing spines. Pygidium subtriangular in outline, the posterior extremity produced into a dorsally-curving, attenuate spine, a little less than one-fourth the total pygidial length. Axis depressed-convex, indistinctly subangular along its median line, about one-fourth the entire width of the pygidium at its anterior margin, its sides nearly straight, gradually converging to the obtusely-rounded posterior extremity, which lies a little anterior to the base of the posterior pygidial spine. Pluræ with no conspicuous marginal border, flattened above, becoming rather strongly convex in the middle, and then sloping away to the lateral margins with a slightly convex surface. Axial segments fifteen in number; pleural segments grooved, eleven in number, curving rather abruptly backward as they approach the margin, the two or three posterior ones nearly straight. Each segment of the pygidium marked by a more or less irregular line of tubercles.

The dimensions of a rather large but imperfect head of this species are: extreme width between genal angles, 60 mm.; length from the

Descriptions of Species in the Middle and Upper Oriskany Faunas.

COELENTERATA.

ANTHOZOA.

TRACHYPORA ORISKANIA n. sp.

Plate XLV., Figs. 1-2.

Description.—Corallum dendroid, with cylindrical branches 6 to 8 mm. in diameter; corallites essentially polygonal in outline, more or less irregularly arranged, from 1 to 2 mm. in diameter, with walls thickened toward their mouths, so that the actual aperture is much smaller and subcircular in outline, being somewhat depressed below the polygonal margin. The outer surface of the thickened walls of the corallites is marked by twelve to fourteen broad, rounded, radiating ridges, separated by sharp, narrow grooves.

Remarks.—This is the oldest recognized member of the genus *Trachypora,* other species being of middle Devonian age. The species may be distinguished by its more conspicuously polygonal corallites, the central circular aperture being much depressed below the polygonal margin.

FAVOSITES sp. undet.

Near Flatbrookville a specimen of *Favosites* has been collected from the calcareous Oriskany beds. It is too poorly preserved to exhibit specific characters, but it somewhat resembles masses of the Helderbergian species *F. helderbergiæ,* but seems to have somewhat smaller

ECHINODERMATA.

CRINOIDEA.

EDRIOCRINUS SACCULUS Hall.

Plate XLV., Figs. 3–5.

1859. *Edriocrinus sacculus* Hall, Pal. N. Y., vol. III., p. 143, pl. 87, figs. 1–22.

Description.—Body free, not having a columnar attachment. Base solid, no sutures recognizable, varying from turbinate to subglobular in form, its upper margin indented by six more or less distinct, shallow, rounded sinuses, which are occupied by the five radial plates and the anal. Radial plates subquadrangular in outline, usually a little wider than long; the proximal margin convex, in contact laterally, except on the posterior side; distally the articulating facets for the arms occupy the entire width of the plates. Anal plate resting upon the base and separating the two posterior radials, quadrangular in outline, higher than wide. Arms free above the radials, broad and flat at the base, consisting of very broad and short brachial plates, which bifurcate somewhere from the ninth to the fifteenth plate, and later bifurcate several more times.

MOLLUSCOIDEA.

BRYOZOA.

FENESTELLA? sp. undet.

Fragments of a fenestelloid bryozoan, too poorly preserved for identification, are not infrequently observed in the basal portion of the Oriskany, associated with the *Orbiculoidea jervensis* fauna.

BRACHIOPODA.

ORBICULOIDEA JERVENSIS Barrett.

Plate XLV., Figs. 7-8.

1878. *Discina jervensis* Barrett, Ann. N. Y. Acad. Sci., vol. I., p. 121.

Description.—Shell broadly suboval or nearly elliptical in outline. Pedicle valve depressed-convex posteriorly and nearly flat anteriorly and laterally, or nearly flat throughout; the apex a little more than one-third the distance from the posterior margin. Internally a prominent, rounded elevation extends from the apex more than half way to the posterior margin, growing narrower posteriorly, with the internal pedicle opening at its posterior extremity. This interior elevation represents the external pedicle groove. Brachial valve depressed-convex, its apex opposite that of the pedicle valve; the surface usually slightly concave from the apex to the posterior margin and convex to the anterior margin. Surface of both valves marked externally by fine, concentric lines of growth, and internally by indefinite, radiating lines, as well as by concentric markings.

The dimensions of an average specimen are: length, 19 mm.; width, 17 mm.

Remarks.—This species occurs abundantly in the basal portion of the Oriskany, in the zone immediately following the trilobite bed. The zone characterized by this species is a well-marked one, and has been definitely recognized from the New York State line to below Hainesville. The external surface of the shells usually adheres to the matrix, so that they are badly exfoliated, the interior surface being more commonly preserved than the exterior. The apical portion of the pedicle valve, including the pedicle opening, is usally destroyed, leaving an irregular, subcentral opening through that valve.

PHOLIDOPS ARENARIA Hall.?

Plate XLV., Fig. 6.

1867. *Pholidops arenaria* Hall, Pal. N. Y., vol. IV., p. 413, pl. 3, fig. 3.

Description.—Shell rather large, subcircular or slightly longitudinally subelliptical in outline. On the casts of the brachial valve the muscular impressions are situated on an abrupt, subcircular elevation a little excentrically located toward the posterior margin, the elevation being somewhat more abrupt posteriorly. The entire marginal border is flattened. The casts of the anterior adductor muscular impressions are excavated from the central elevation; they are subovate or subelliptical in outline, their axes diverging posteriorly, and are separated by a median ridge or elevation which is narrow in front but grows rapidly broader posteriorly. The external surface characters have not been observed.

PHOLIDOPS OVATA Hall.

See, also, p. 226, pl. XX.

The internal casts of a small species of *Pholidops* are occasionally observed in the Oriskany formation of New Jersey, which apparently do not differ in any essential particular from those in the earlier faunas which have been identified as *P. ovata.*

STROPHEODONTA MAGNIFICA Hall.

Plate XLV., Figs. 10–11.
See, also, p. 324.

1859. *Strophodonta magnifica* Hall, Pal. N. Y., vol. III., p. 414, pl. 93, fig. 4, pl. 94, figs. 2 *a–d,* pl. 95, fig. 8, pl 95 *A,* 15–19.

Description.—Shell subsemi-elliptical in outline, hinge-line equaling or a little shorter than the greatest width; cardinal extremities angular or somewhat rounded. Proportions of length to breadth varying from longer than broad to broader than long. Pedicle valve depressed-convex near the beak; flattened laterally and anteriorly, cardinal margins sloping gently from the beak, cardinal area narrow, marked by vertical lines which indicate the position of the marginal crenulations. Internally the valve is marked by a large and broadly-flabellate muscular impression, beyond which the internal surface is papillose, giving to the surface of internal casts a punctate appearance. Brachial valve slightly concave or nearly flat. Surface of both valves marked by fine, radiating striæ, which increase by bifurcation.

The dimensions of a somewhat distorted specimen are: length, 30 mm.; width, 34 mm.

Remarks.—The shell which is identified as *Stropheodonta magnifica* is one of the common members of the Oriskany fauna in New Jersey, but it has never been observed to attain the large size ascribed to it by Hall. It agrees closely, however, so far as it is preserved, with Hall's illustrations of the smaller specimens of his species, and there can scarcely be any doubt as to the specific identity of the New York and the New Jersey specimens. The most common occurrence of the species is in the condition of internal casts of the pedicle valve, upon which the cast of the flabellate muscular impression and the punctate surface are always conspicuous characters.

LEPTAENA RHOMBOIDALIS (Wilck.) var. VENTRICOSA (Hall).

Plate XLVI., Fig. 1.

1859. *Strophomena rugosa* var. *ventricosa* Hall, Pal. N. Y., vol. III., p. 417, pl. 94, figs. 2 *e–f*, 3.

The variety of this cosmopolitan species, which occurs in the Oriskany beds, differs markedly from its earlier representatives in the New Jersey faunas. The pedicle valve is more or less strongly convex toward the beak, not conspicuously flattened, as is the condition of the more usual members of the species, and because of this convexity posteriorly, the valve does not have the usual geniculation toward the front, but is strongly convex or gibbous. The concentric wrinkles are also much stronger, broader and further apart on these Oriskany specimens, giving to the shell altogether a different appearance than the typical form of the species. The brachial valve is strongly concave and is much more coarsely marked than is usually the case in the typical form of the species.

This shell is quite generally distributed in the Oriskany beds of New Jersey, but has never been observed in great abundance and is always imperfectly preserved. It sometimes attains a great size, one and front margins; beak obtuse, not incurved; cardinal area of moderate height, flat; delthyrium broadly triangular, closed by a deltidium. Brachial valve regularly convex, the greatest elevation near the middle. Surface of both valves marked by rather coarse, radiating striæ, which increase by bifurcation and which become stronger toward the margin of the shell. Toward the cardinal margin the radiating striæ curve posteriorly as they approach the margin.

The approximate dimensions of an imperfect cast of the brachial valve are: length, 32 mm.; width, 32 mm.

Remarks.—This is a rare species in the Oriskany fauna of New Jersey, and no specimens attaining the great size of some of those from New York have been observed. The New Jersey specimens studied are all imperfect casts of the brachial valve, and do not at all fairly represent the species.

ORTHOTHETES sp. undet.

Plate XLV., Fig. 9.

Several imperfect specimens of a species of *Orthothetes* have been observed associated with the *Orbiculoidea jervensis* fauna of the Oriskany formation, but they are too imperfect for identification.

The dimensions of one of the best ones are: length, 12 mm.; width, 16.5 mm.

CHONETES HUDSONICA Clarke.

Plate XLVI., Fig. 11.

1900. *Chonetes hudsonica* Clarke, Mem. N. Y. St. Mus., No. 3, vol. III., p. 49, pl. 7, figs. 1–6.

Description.—Shell of medium or small size, hinge-line equaling the greatest width; cardinal extremities angular, lateral margins subparallel for a short distance, then curving rather abruptly into the broadly-rounded anterior margin. Greatest convexity of the pedicle valve posterior to the middle, slightly flattened toward the cardinal extremities. Surface marked by fine, rounded costæ, with rounded interspaces, increasing by bifurcation and implantation, a shell 11 mm. wide bearing from eighty to ninety costæ at the margin. Cardinal margin marked by two or three spines on each side of the beak, of which the outermost ones are directed more obliquely outward than the second ones. Brachial valve not observed.

The dimensions of a nearly-perfect pedicle valve are: length, 7.5 mm.; width, 11 mm.

Remarks.—This species is one of the rarest in the New Jersey Oriskany fauna, and has been observed only as a member of the *Orbiculoidea jervensis* fauna. It seems to be identical with the little shell from New York described by Clarke as *C. hudsonicus*.

CHONOSTROPHIA COMPLANATA (Hall).

Plate XLVI., Fig. 12.

1859. *Chonetes complanata* Hall, Pal. N. Y., vol. III., p. 418, pl. 93, figs. 1 *a–d*.

Description.—Shell semi-circular to semi-elliptical in outline, broader than long, greatest width along the hinge-line; cardinal extremities usually nearly rectangular. Pedicle valve depressed-convex on the umbo, nearly flat or concave toward the lateral and front margins; the cardinal margin with three or four tubular spines, directed obliquely outward, on each side of the beak; cardinal area narrowly linear. Brachial valve depressed-convex, flattened toward the cardinal extremities, most prominent near the middle. Surface of both valves

ANOPLIA NUCLEATA (Hall).

Plate XLVI., Figs. 8–10.
See, also, p. 325.

1859. *Leptæna? nucleata* Hall, Pal. N. Y., vol. III., p. 419, pl. 94, figs. 1 *a–d*.

Description.—Shell small, subsemi-circular or subsemi-elliptical in outline, a little wider than long; hinge-line equaling or a little less than the greatest width; cardinal extremities angular or obtusely rounded. Pedicle valve strongly convex or gibbous, slightly flattened toward the cardinal angles; beak strongly incurved; cardinal area narrow, sloping dorsally from the plane of the valve. Internally a strong median septum extends anteriorly from the beak for about one-third the length of the valve. Surface smooth.

The dimensions of an average-sized specimen are: length, 5 mm.; width, 6.5 mm.

Remarks.—This little shell has not been observed to occur abundantly in the Oriskany fauna of New Jersey. Its usual condition of preservation is in the form of internal casts, in which the slit, extending anteriorly from the beak and representing the medium septum of the pedicle valve, is a conspicuous character.

RHIPIDOMELLA sp. cf. R. MUSCULOSA (Hall).

1859. *Orthis musculosa* Hall, Pal. N. Y., vol. III., p. 409, pl. 91, figs. 1–3, pl. 95, figs. 1–7.

In an Oriskany fauna from near Layton there have been observed a few imperfect specimens of a species of Rhipidomella which may be *R. musculosa.* The specimens are all smaller than the normal, full-grown individuals of that species, usually not exceeding 18 mm. in length. The characteristic muscular impression has not been observed, and, although the specimens have a close general resemblance to the smaller individuals of *R. musculosa,* it is difficult to determine in what respect they differ from some Helderbergian species.

RHIPIDOMELLA OBLATA (Hall).

Plate XLVI., Figs. 5–7.
See, also, p. 304, pl. XXXV.

In the middle zone of the New Jersey Oriskany, associated with *Orbiculoidea jervensis*, *Metaplasia plicata*, &c., there occurs somewhat commonly a large species of Rhipidomella which seems to be identical in all respects with the Helderbergian *R. oblata*.

RHYNCHONELLA BREVIPLICATA n. sp.

Plate XLVI., Figs. 2–4.

Description.—Shell subcircular, slightly wider than long. Pedicle valve convex, depressed towards the front in a shallow, mesial sinus, which is produced anteriorly into a lingual extension at nearly right angles to the plane of the valve; cardinal margins abruptly inflected, slightly concave, forming an angle of about 90° at the beak; beak acute, not strongly incurved. Brachial valve much more strongly convex than the pedicle; elevated toward the front in a low, mesial fold. Surface of both valves smooth posteriorly or marked only by very fine, indistinct, radiating lines; towards the margin there are genus. The internal characters of the shell have not been observed, so that no proper generic reference of the species can be made at the present time, it being, therefore, referred provisionally to Rhynchonella.

CAMAROTOECHIA BARRANDEI (Hall).

A fragment of a large Rhynchonelloid shell found in the calcareous Oriskany beds near the New York State line seems to represent the species *Camarotœchia barrandei.*

EATONIA PECULIARIS (Con.).

Plate XLVII., Figs. 1–4.

1859. *Eatonia peculiaris* Hall, Pal. N. Y., vol. III., p. 244, pl. 38, figs. 21–26, pl. 101, fig. 2; also, p. 436, pl. 101, figs. 2 *a–g*, pl. 101 *A*, figs. 1 *a–h*.

Description.—Shell usually longer than broad, sometimes the length and breadth nearly equal, subovate in outline; the cardinal margins meeting at the beak in an angle usually a little less than 90°. Pedicle valve depressed-convex on the umbo, inflected along the cardinal border, flattened laterally, depressed toward the front in a deep mesial sinus, which is more or less produced in a lingual extension anteriorly; beak rather small, closely incurved over that of the opposite valve. Brachial valve strongly convex, with a mesial fold conspicuous toward the front, but obsolete posterior to the middle. Surface of both valves marked by fine, radiating striæ, which increase by bifurcation, and usually by a few inconspicuous, concentric lines of growth. On the lateral margins adjacent to the fold and sinus there are usually two or three slight denticulations, which may be produced backward upon the surface of the valves for a short distance as indistinct plications. The dimensions of a large individual are: length, 27 mm.; width, 23 mm.; thickness, 15.5 mm.

Remarks.—There is some doubt as to whether the specimens in the Oriskany fauna of New Jersey which have been identified as *Eatonia peculiaris* should not be considered as a variation of *Eatonia singularis.* These two species are closely allied, and seem to grade from one into the other by almost imperceptible variations. In New Jersey the Oriskany specimens are more elongate than the Helderbergian *E. singularis,* the inflection of the cardinal border of the pedicle valve is more conspicuous and the strong median stria is much less conspicuous, and sometimes may not be recognized at all. The denticulation of the lateral margins of the two valves is absent from the Helderbergian specimens, but this is not a conspicuous feature of the Oriskany specimens, and may apparently be absent altogether in some cases.

BEACHIA SUESSANA (Hall).

Plate XLVII., Figs. 5–14.

1859. *Rensselæria suessana* Hall, Pal. N. Y., vol. III., p. 459, pl. 107, figs. 1–15.

Description.—Shell longitudinally subovate or sub-elliptical in outline, usually longer than wide; hinge-line shorter than the greatest width. Pedicle valve moderately convex, most elevated along the median line posterior to the middle, sometimes more or less flattened laterally; the lateral margins in adult shells sometimes abruptly inflected; beak sharply pointed, incurved, but not touching the opposite valve, perforated at the apex by a small, circular foramen; delthyrium closed by deltidial plates above and by the cardinal process of the brachial valve below; cardinal margin abruptly inflected, forming a false cardinal area. Brachial valve a little less convex than the pedicle, specimens, having the strong, concentric lines of growth and the obsolete, radiating plications, seem to be essentially like the shell from New York which is known as *Megalanteris ovalis* (Hall). This shell from New York, however, has never exhibited the brachidium, so that it is not really known to be a member of the genus to which it has been referred. A specimen from New Jersey retains the brachidium, however, and it is essentially the same as that of *Beachia suessana* as known from Cumberland, Maryland. This would indicate either that *M. ovalis* and *B. suessana* are synonymous, representing extreme variations in the surface markings, or that they are two distinct species, both belonging to the genus *Beachia*.

SPIRIFER ARENOSUS (Con.).

Plate XLVIII., Fig. 5.

1859. *Spirifer arenosus* Hall, Pal. N. Y., vol. III., p. 425, pl. 98, figs. 1–8, pl. 99, figs. 1–10, pl. 100, figs. 1–8.

Description.—Shell large, subsemi-circular, subsemi-elliptical or subelliptical in outline; hinge-line equaling the greatest width of the shell or a little shorter; cardinal extremities angular or rounded. Pedicle valve strongly convex or gibbous on the umbo; the surface somewhat flattened toward the cardinal angles and curving regularly toward the front, depressed along the median line in a shallow, rounded, more or less ill-defined mesial sinus; beak prominent, somewhat incurved; cardinal area becoming rather wide in old shells, concave, sharply defined, reaching to the extremities of the hinge-line; delthyrium broadly triangular. Internally the muscular impressions are large and deep. Brachial valve with its greatest convexity near the middle; mesial fold low, rounded, more or less ill-defined. Surface of both valves marked by from fifteen to twenty depressed, rounded plications on each lateral slope. The fold and sinus are also similarly plicated, but on these portions of the shell the plications increase in number by bifurcation, those on the sides being simple. The surface is also marked by fine, concentric striæ and by stronger, imbricating lines of growth.

The dimensions of an imperfect brachial valve are, approximately: length, 44 mm.; width, 56 mm.; convexity, 20 mm.

Remarks.—This very characteristic Oriskany species is one of the very rarest members of the fauna in New Jersey. It may always be easily recognized by its large size when adult and by its completely plicated valves, it having no associates in the same genus which do not have a smooth fold and sinus.

SPIRIFER MURCHISONI Castelnau.

Plate XLVIII., Figs. 1–4.

1859. *Spirifer arrectus* Hall, Pal. N. Y., vol. III., p. 422, pl. 97, figs 1 *a–h*, 2 *a–i*.

Description.—Shell semi-circular to semi-elliptical in outline, greatest width usually along the hinge-line; cardinal angles usually angular, rarely a little rounded, often somewhat mucronate. Pedicle valve gibbous on the umbo; the surface slightly flattened toward the cardinal angles, regularly curved to the front; mesial sinus sharply defined, subangular or rounded in the bottom; beak incurved; cardinal area high, sharply defined, concave toward the beak. Brachial valve strongly convex, more or less flattened toward the cardinal extremities; the subangular fold usually greatly elevated towards the front. Surface of both valves marked by from five to eight simple,

CYRTINA VARIA Clarke.

Plate XLVIII., Figs. 13–16.

1900. *Cyrtina varia* Clarke, Mem. N. Y. State Mus. Nat. Hist., vol. III., No. 3, p. 49, pl. 6, figs. 15–22.

Description.—Shell obliquely subpyramidal, its greatest width along the hinge-line; cardinal extremities angular, at times somewhat mucronate. Pedicle valve greatly elevated at the beak, sloping away to the lateral and front margins, with a well-defined, narrow mesial sinus extending from the beak to the front margin; beak pointed, a little incurved; cardinal area about twice as wide as high, flat or a little concave toward the beak; delthyrium narrowly triangular, closed below by the deltidial plates, the elongated foramen occupying the upper portion just beneath the beak. Interiorly the dental lamellæ unite at their bases and are continued as a mesial septum, which extends nearly to the anterior margin of the shell. Brachial valve depressed-convex, flattened towards the cardinal extremities; mesial fold low, rounded or slightly flattened, with a faint, median, depressed line. Surface of each valve marked by from six to nine simple, rounded or subangular plications on each side of the fold and sinus and by fine, imbricating, concentric, lamellose lines of growth.

The dimensions of a nearly-perfect specimen are: length of brachial valve, 10 mm.; width of same, 17 mm.; height of cardinal area of pedicle valve, 7 mm.

METAPLASIA PYXIDATA (Hall).

Plate XLVIII., Fig. 6.

1859. *Spirifer pyxidatus* Hall, Pal. N. Y., vol. III., p. 428, pl. 100, figs. 9–12.

Description.—Shell semi-elliptical to subtriangular in outline; hinge-line about equal to the greatest width; cardinal extremities angular or a little rounded. Pedicle valve gibbous on the umbo and strongly elevated medially to the anterior margin, flattened toward the cardinal extremities, with a narrow mesial groove or sinus on the summit of the mesial elevation; cardinal area narrow and linear; the beak rather blunt, incurved. Brachial valve flattened on the umbo and toward the lateral margins, depressed medially in a broad sinus, along the median line of which is a small, elevated ridge. The surface of perfectly-preserved specimens is marked by fine, concentric and radiating striæ.

The dimensions of an imperfect pedicle valve are, approximately: length, 8 mm.; width, 10 mm.; convexity, 3.5 mm.

METAPLASIA PLICATA n. sp.

Plate XLVIII., Figs. 7–12.

Description.—Shell subcircular or subelliptical in outline, wider than long, greatest width along the hinge-line, cardinal extremities angular. Pedicle valve strongly convex, having a prominent mesial elevation extending from the beak to the front margin, with a rounded longitudinal depression. From this mesial elevation the surface slopes away somewhat gradually to the lateral margins and curves rather abruptly to the cardinal margin; the beak is prominent and strongly incurved; the cardinal area is of moderate width, sharply defined and extending to the cardinal extremities. Brachial valve depressed-convex on the umbo, flattened toward the cardinal margins, flat or concave laterally, depressed medially toward the front tremely fine radiating striæ and usually by a few lamellose lines of growth.

The dimensions of the most-nearly perfect specimen observed are: length, 12 mm.; width, 19 mm.; thickness, 8.5 mm.

Remarks.—This species is very abundant at Locality 6 A, near Montague post-office. The pedicle valves are by far the most abundant, only a few brachial valves having been observed. One of these, an interior, preserves the primary lamellæ of the brachidium, each with a short jugal process near the centre of the valve, pointing towards the pedicle valve, but not joined together to form a jugum, the brachidium being similar to that of the genus *Spirifer.* In some cases the brachial valve appears to be nearly flat throughout, or has a slight, general convexity. The species differs from either of the other members of the genus in its greater size and in its strongly-plicated shell.

ANOPLOTHECA FLABELLITES (Con.).

Plate XLIX., Figs. 1–2.

1859. *Leptocœlia flabellites* Hall, Pal. N. Y., vol. III., p. 449, pl. 103 *B,* figs. 1 *a–f,* pl. 106, figs. 1 *a–f.*

Description.—Shell semi-elliptical, subcircular or subovate in outline, usually broader than long; the cardinal extremities rounded. Pedicle valve convex, most prominent towards the beak, sloping rather abruptly to the cardinal margin and more gently to the lateral margins, more or less depressed medially toward the front in a narrow sinus, with a single plication in the bottom; beak pointed, rather strongly incurved, with a circular foramen in the apex; delthyrium closed in its lower part by a pair of deltidial plates. Brachial valve flat, with a low, narrow mesial fold in the anterior half, marked by two plications; the cardinal margins diverging from the beak at a variable angle of from 110° to 150°. Surface of each valve marked by from twelve to sixteen simple, rounded or subangular, radiating plications, of which two somewhat larger ones, with a smaller one between, occupy the median portion of the pedicle valve, the smaller median one being depressed between the larger ones toward the front into a narrow and more or less prominent sinus. On the brachial valve the two median plications are somewhat elevated above the others anteriorly in a narrow mesial fold. The surface is also marked by concentric lines of growth, which usually become more crowded toward the margin.

The dimensions of a rather small specimen are: length, 13 mm.; width, 15 mm.; thickness, 4 mm.

ANOPLOTHECA DICHOTOMA (Hall).

Plate XLIX., Figs. 3–6.

1859. *Leptocœlia dichotoma* Hall, Pal. N. Y., vol. III., p. 452, pl. 103 *B,* figs. 3 *a–c.*

Description.—Shell broadly subovate in outline, concavo-convex. Pedicle valve strongly convex, its greatest elevation near the middle, with a flat-topped mesial elevation, from which the surface slopes away to the lateral margins; beak sharply pointed, incurved. Brachial valve flattened laterally, with a rather broad, ill-defined mesial sinus extending from the beak to the front margin. Surface of each valve marked by from fourteen to sixteen rounded or subangular, radiating plications, which increase by bifurcation, although in some cases the bifurcations are so close to the beak that the plications almost seem to be simple. The plications are crossed by a few sublamellose, concentric lines of growth.

The dimensions of a nearly-perfect specimen are: length, 9 mm.;

MERISTELLA LATA (Hall).

Plate XLVII., Figs. 15–20.

1859. *Merista lata* Hall, Pal. N. Y., vol. III., p. 431, pl. 101, figs. 3 *a–m*.

Description.—Shell transversely subelliptical, subrhomboidal, or longitudinally suboval in outline, usually wider than long. Pedicle valve strongly convex, its greatest elevation near the middle, with a rounded mesial sinus of moderate depth toward the front, the beak incurved over that of the opposite valve. Internally the muscular impressions are large and strongly-defined. Brachial valve nearly as convex as the pedicle, often somewhat flattened laterally, with an ill-defined mesial fold toward the front. Surface of both valves marked by fine, concentric striæ and by a few stronger, sublamellose lines of growth.

The dimensions of an average specimen are: length, 30 mm.; width, 34 mm.

Remarks.—This species is never well preserved in the Oriskany formation of New Jersey, and usually occurs in the form of internal casts of the pedicle valve. Such specimens may always be easily recognized by the broad and strongly-elevated cast of the muscular impression. The species is a common one and may usually be detected wherever fossils are present in this formation.

MOLLUSCA.

PELECYPODA.

ACTINOPTERIA INSIGNIS Clarke (?).

Plate L., Fig. 2.

1900. *Actinopteria insignis* Clarke, Mem. N. Y. St. Mus., No. 3, vol. III., p. 35, pl. 4, figs. 10–13.

Several imperfect examples of a winged pelecypod shell having the size and characteristics, so far as they can be determined, of

Actinopteria insiginis have been observed in the *Orbiculoidea jervensis* fauna of the Oriskany. Associated with them are fragments of other winged shells, which may belong to some other species of the same genus or to *Pterinea*.

ACTINOPTERIA TEXTILIS (Hall) var. ARENARIA (Hall).

Plate L., Fig. 1.

1859. *Avicula textilis* var. *arenaria* Hall, Pal. N. Y., vol. III., p. 465, pl. 109, figs. 1–2, pl. 110, fig. 2.

Description.—Shell large, obliquely subovate, the proportions of length and height variable. Left valve becoming moderately and regularly convex from the base, the greatest convexity being about the first third below the hinge-line. Posterior wing large, extending along the margin of the body of the shell half way from beak to base. Anterior wing small, triangular, wrinkled. Surface marked by strong, radiating ribs, sometimes regularly dichotomosing and subequal, and in other specimens quite unequal, showing a few stronger ribs, with several finer ones between, and these are crossed by strongly-elevated, imbricating lamellæ. The right valve is slightly concave, smaller than the other, faintly marked by the radiating ribs, which sometimes are little in front of the middle; margin convexly rounded from the anterior extremity of the hinge-line to about the middle of the anterior ide of the shell, where it is conspicuously sinuate; from this sinus t is again convexly rounded ventrally and posteriorly to the angular osterior extremity of the hinge-line. The body of the valve is oderately convex, the greatest elevation being above the middle. nteriorly a convex wing is separated from the body of the shell by a ther narrow and abruptly-depressed, rounded sinus, which extends om a point just in front of the beak to the sinuosity of the anterior argin, the greatest elevation of this wing being about one-half that the body of the shell. Surface of the entire valve marked by fine, ttened, radiating costæ and by conspicuous, concentric lines of owth. Right valve unknown.

The dimensions of an imperfect specimen are: height, 39 mm.; dth, about 39 mm.; convexity, 10 mm.

Remarks.—But a single imperfect specimen of the left valve of this ecies has been observed. It is in the condition of an internal cast, on which the radiating surface markings are less sharply defined an upon the actual surface of the shell. It agrees essentially, so r as it is preserved, with Hall's original illustration of the species, d there can be no doubt as to its correct identification.

GASTROPODA.

PLATYOSTOMA VENTRICOSA Con.

Plate XLIX., Figs. 7–11.

859. *Platyostoma ventricosa* Hall, Pal. N. Y., vol. III., p. 469, pl. 112, figs. 1–10, pl. 113, figs. 7–8, pl. 115, fig. 8; also, p. 475, pl. 118, figs. 3–9.

Description.—Shell variable, more or less subglobular in form, consisting of three or four rather rapidly-expanding volutions, which may be contiguous throughout or the outer one may be more or less free. Spire not at all or but moderately elevated above the outer volution. Aperture slightly oblique, subcircular, suboval or subelliptical in outline. Surface marked by fine, more or less irregular, transverse lines of growth, which are sometimes more or less fasciculate at intervals.

The dimensions of a very large individual are: maximum diameter, 85 mm.; maximum height, 55 mm. Those of a smaller specimen are: maximum diameter, 28 mm.; maximum height, 25 mm.

Remarks.—As it usually occurs in the Oriskany fauna of New Jersey, this species does not attain the great size of the specimen whose dimensions are given above, the average size being from 30 mm. to 40 mm. in diameter. The species is exceedingly variable, and all of the specimens of this general type so far recognized in the Oriskany of New Jersey seem to be included within the limits of this species as recognized by Hall.

PLATYOSTOMA DESMATUM (Clarke).

Plate XLIX., Fig. 12.

1900. *Diaphorostoma desmatum* Clarke, Mem. N. Y. St. Mus., No. 3, vol. III., p. 29, pl. 3, figs. 13–19.

This species agrees in all respects, except size and surface markings, with *P. ventricosa.* It does not grow so large as that species, the largest individual observed being 25 mm. in diameter and 18 mm. high. The surface markings differ from *P. ventricosa* in having, in addition to the transverse lines of growth, which are finer and more regular, other fine revolving lines most prominent in the interspaces between the transverse lines, which give to the surface of the shell a

The dimensions of the only specimen observed are: height, 17 mm.; maximum diameter of aperture, 14 mm.

Remarks.—A single specimen from the New Jersey Oriskany collection probably represents this species. It differs chiefly from the typical form of the species, as illustrated by Hall, in its less elevation.

PTEROPODA.

TENTACULITES ELONGATUS Hall.

Plate L., Figs. 4–5.
See, also, pp. 295 and 319.

859. *Tentaculites elongatus* Hall, Pal. N. Y., vol. III., p. 136, pl. 6, figs. 16–21.

900. *Tentaculites elongatus* Clarke, Mem. N. Y. State Mus., No. 3, vol. III., p. 27, pl. 3, figs. 8–12.

Description.—Shell elongate, circular in cross-section, annulate, radually tapering to the apex. Annulations strong, subangular or ounded, two of them occupying the space of 3 mm. near the larger nd of adult shells, while at the smaller end they are less than 1 mm. part. Entire surface covered by fine, annular striæ, which are most onspicuous in the depressions between the annulations, and are often early obsolete upon the outermost portion of the annulations. Inernal casts lack the fine, annular striæ, and the annulations have the ppearance of a series of insheathed cones, with their apices toward he larger end of the shell.

Some of the larger individuals attain the following dimensions: ength, 60 to 70 mm.; larger diameter, 6 mm.

Remarks.—This species makes its first appearance in the Coeymans limestone, where it is one of the rare species, and continues through the Helderbergian formations, but never in great abundance. It is most conspicuous in the Oriskany formation, where it sometimes occurs crowded together in great numbers. Its most usual occurrence is in the form of internal casts, the fine surface striæ being only detected in the moulds of the exterior of the shell.

CEPHALOPODA.

ORTHOCERAS sp. undet.

A single fragmentary specimen, which is probably the cast of a portion of the chamber of habitation of a species of *Orthoceras*, has been observed in the *Orbiculoidea jervensis* fauna.

ARTHROPODA.

TRILOBITA.

DALMANITES sp. undet.

Plate L., Fig. 6.

A few more or less fragmentary specimens of the pygidia of *Dalmanites* have been observed in the Oriskany fauna of New Jersey. These specimens may represent more than one species, but they are too imperfect for identification, especially in the absence of any of the cephalic characters. The most nearly-perfect specimen is a large pygidium from near the New York State line, north of the Nearpass section, and, when complete, the specimen must have had a length of

ONS OF SPECIES IN THE ONONDAGA LIMESTONE FAUNA.

COELENTERATA.

ANTHOZOA.

ZAPHRENTIS sp. undet.

ns of one or more species of horn corals are occasionally in the Onondaga limestone, but none of those observed are ough for specific identification. They may be referred pro-to the genus *Zaphrentis*.

MOLLUSCOIDEA.

BRYOZOA.

FENESTELLA? sp. undet.

ns of the fenestelloid type are sometimes present in the limestone, but in no case have they been found to be pre-uch a condition as to allow of their identification.

BRACHIOPODA.

LINGULA sp. undet.

fragment of a rather large linguloid shell has been noticed ndaga limestone. When complete the specimen must have th of 16 or 18 mm., but the fragment preserved is not suffi-dentification.

STROPHEODONTA PERPLANA (Con.).

Plate LI., Figs. 12–13.

1867. *Strophodonta perplana* Hall, Pal. N. Y., vol. IV., p. 98, pl. 11, fig. 22, pl., 12, figs. 13–15, pl. 17, figs. 1 *a–o*.

Description.—Shell subsemi-elliptical in outline, the hinge-line usually equaling, but sometimes a little less than, the greatest width of the shell; cardinal extremities angular, proportional length and breadth variable; lateral margins often more or less sinuate immediately in front of the cardinal angles.. Pedicle valve depressed-convex on the umbo, nearly flat towards the lateral and anterior margins; beak scarcely projecting beyond the hinge-line; cardinal area narrow, linear. Brachial valve nearly flat, leaving but a very narrow interspace between the two valves. Surface of both valves marked by fine, subequal, radiating costæ, which increase by bifurcation and by intercalation, those of the pedicle valve being somewhat finer than those of the brachial valve.

The approximate dimensions of a very imperfect specimen are: length, 12 mm.; width, 20 mm.

Remarks.—The only specimens of this species which have been observed in the Onondaga limestone of New Jersey are considerably smaller than the average size of the species as it usually occurs in the Middle Devonian faunas of New York and the west. The specimens are very imperfect and scarcely serve to illustrate the characters of

ORTHOTHETES PANDORA (Bill.).

See, also, pp. 373 and 380.

1867. *Streptorhynchus pandora* Hall, Pal. N. Y., vol. IV., p. 68, pl. 4, figs. 11–19, pl. 9, figs. 18–25, 27.

Description.—Shell semi-circular or semi-elliptical in outline, hinge-line equaling the greatest width of the shell, cardinal angles nearly rectangular. Pedicle valve convex, greatest elevation at the beak, from which point the surface slopes away regularly with a slight convex curve to the lateral and anterior margins; beak obtuse, not incurved; cardinal area rather high, sloping a little posteriorly, flat or slightly concave. Brachial valve depressed-convex, flattened toward the cardinal angles. Surface of both valves marked by numerous, fine, strongly-elevated, radiating costæ, which increase by bifurcation and by intercalation.

The dimensions of a nearly-perfect pedicle valve are: length, 10 mm.; width, 14 mm.; convexity, 3 mm.

Remarks.—More or less fragmentary specimens of this species have been found in the Onondaga limestone at several localities in New Jersey.

CHONETES ARCUATUS Hall.

Plate LI., Fig. 18.

867. *Chonetes arcuata* Hall, Pal. N. Y., vol. IV., p. 119, pl. 20, figs. 7 *a–f*.

Description.—Shell semi-circular or semi-elliptical in outline; hinge-line equaling the greatest width; cardinal extremities angular. Pedicle valve gibbous, somewhat depressed toward the cardinal angles, a little flattened along the median line from the beak to the anterior margin; the beak strongly incurved, the cardinal margins sloping gently from the beak to the cardinal extremities, bearing about seven or eight spines, pointing in a slightly oblique direction outward, on each side of the beak. Surface marked by fine, radiating costæ, which increase by intercalation and rarely by bifurcation, about one hundred being present on the margin of a shell 17 mm. wide, and crossed also by much finer, crowded, concentric striæ. Brachial valve not seen, but it is apparently deeply concave.

The dimensions of the best specimen observed are: length, 12 mm.; width, 17 mm.; convexity, 6 mm.

Remarks.—In common with most of the Onondaga limestone fossils, this species is represented only by fragmentary specimens. The New Jersey specimens are smaller than the typical New York representatives of the species as illustrated in the New York Paleontology, but they seem to agree with the characters of *C. arcuatus* more closely than with any other species. The species may be recognized by its fine, radiating markings and its slight mesial flattening or depression of the pedicle valve.

RHIPIDOMELLA VANUXEMI (Hall).

Plate LI., Figs. 5–7.

1867. *Orthis vanuxemi* Hall, Pal. N. Y., vol. IV., p. 47, pl. 6, figs. 3 *a–r*.

Description.—Shell subcircular or suboval in outline; hinge-line much shorter than the greatest width of the shell; cardinal extremities rounded. Pedicle valve depressed-convex on the umbo, flattened or a little concave toward the lateral and front margins; beak small, extended but little beyond that of the opposite valve, but little incurved; cardinal area small, concave. Brachial valve convex; the beak scarcely

ATRYPA RETICULARIS (Linn.).

Plate LI., Figs. 1–4.
See, also, pp. 236 and 286.

The specimens of this species which occur in the Onondaga limestone are not essentially different from its earlier representatives.

SPIRIFER sp. undet.

A few fragments of a small, rather coarsely-ribbed species of *Spirifer,* with strong, lamellose lines of growth, have been detected in the Onondaga limestone. The specimens have somewhat the aspect of *Spirifer varicosus* Hall, but in no case are they sufficiently well preserved to be identified with certainty.

RETICULARIA FIMBRIATA (Con.).

Plate LI., Figs. 8–11.

1867. *Spirifera fimbriata* Hall, Pal. N. Y., vol. IV., p. 214, pl. 33, figs. 1–21.

Description.—Shell transversely subelliptical in outline; hinge-line shorter than the greatest width; cardinal extremities rounded. Pedicle valve strongly convex on the umbo, the surface sloping in a regular curve to the lateral and front margins, but curving much more abruptly to the cardinal margins; depressed along the median line in a more or less sharply-defined, shallow, rounded sinus; beak small, incurved over the area; cardinal area rather high, concave, not sharply defined. Brachial valve a little less convex than the pedicle, often somewhat flattened toward the cardinal extremities; mesial fold rather abruptly elevated in front, but scarcely defined at the beak. Surface of each valve marked by from five to eight low, rounded, obscure plications on each side of the fold and sinus, and by more or less imbricating, concentric lamellæ of variable width, each one of which is marked by a row of small, radially elongate nodes having somewhat the appearance of interrupted radiating costæ, and which are really the bases of parallel, concentric rows of spines.

The dimensions of a nearly-perfect specimen from the Hamilton shale of New York are: length, 22 mm.; width, 25 mm.; thickness, 15 mm.

Remarks.—This species is rarely represented in the Onondaga limestone of New Jersey, the only specimens observed being imperfect impressions of the exterior. These impressions, however, retain the characteristic surface markings of the species, and indicate a shell which was in no essential particulars different from the Onondaga and Hamilton representatives of the species in New York. The above description has been drawn up from New York specimens in the absence of satisfactory material in the New Jersey collections.

ANOPLOTHECA ACUTIPLICATA (Con.).

Plate LI., Figs. 14–17.
See, also, pp. 377 and 383.

1867. *Leptocœlia acutiplicata* Hall, Pal. N. Y., vol. VI., p. 365, pl. 57, figs. 30–39.

Description.—Shell plano-convex, subcircular or subovate in outline. Pedicle valve moderately convex, its greatest elevation near the centre; beak acute, incurved so that it points at about right angles

ANOPLOTHECA CONCAVA (Hall).

See, also, p. 316, pl. XXXVII.

Specimens of a small species of *Anoplotheca*, indistinguishable from specimens in the New Scotland beds of the Helderbergian series, have been observed in the Onondaga limestone at several localities. Hall, after first referring this Onondaga limestone shell to the Helderbergian species,* afterwards established a new species for it, with the name *camilla*,† but the New Jersey specimens at least cannot be distinguished from *A. concava*.

MOLLUSCA.

GASTROPODA.

PLATYCERAS sp. undet.

Fragments of capulid shells, which may be referred to the genus *Platyceras*, are occasionally met with in the Onondaga limestone, but no specimens perfect enough for specific identification have been seen.

LOXONEMA sp. undet.

Plate LI., Fig. 20.

A few specimens of an elongate, coiled shell have been observed in the Onondaga limestone. All are too imperfect for identification, but may be referred provisionally to the genus *Loxonema*.

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* Pal. N. Y., vol. IV., p. 329.

† Pal. N. Y., vol. IV., pl. 52, figs. 13–19.

DESCRIPTION OF SPECIES IN THE NEWFOUNDLAND GRIT FAUNA.

COELENTERATA.

ANTHOZOA.

ZAPHRENTIS sp. undet.

In the Newfoundland locality of this formation specimens of horn coral are not of infrequent occurrence. All the specimens observed are imperfect casts of the cup, which retain neither specific nor generic characters sufficient for identification. All may be provisionally referred to the genus *Zaphrentis*. The largest specimen observed has a maximum diameter of 45 mm.

MOLLUSCOIDEA.

BRACHIOPODA.

STROPHEODONTA INEQUIRADIATA Hall.

ORTHOTHETES PANDORA (Bill.).

Plate LII., Fig. 8.
See, also, pp. 367 and 380.

1867. *Streptorhynchus chemungensis* var. *pandora* Hall, Pal. N. Y., vol. IV., p. 68, pl. 4, figs. 11–19, pl. 9, figs. 18–25, 27.

Some imperfect specimens of *Orthothetes* from the Greenwood lake locality may quite certainly be referred to the species *O. chemungensis* or some variety of it. Members of this species are characterized by the nearly-flat pedicle valve, with straight hinge-line usually equaling the greatest width of the shell, with the cardinal extremities varying either way from rectangular, and often with a more or less distorted beak. The brachial valve is more convex than the other. Both valves are marked by fine, radiating costæ, which increase by intercalation and by bifurcation. The New Jersey specimens agree most closely with the illustrations of the variety *pandora* and may be referred to that form without much doubt.

CHONETES ARCUATUS Hall.

Plate LI., Fig. 21.

1867. *Chonetes arcuata* Hall, Pal. N. Y., vol. IV., p. 119, pl. 20, figs. 7 *a–f*.

Description.—Shell semi-elliptical or semi-circular in outline, the hinge-line straight, about equaling the greatest width; cardinal extremities rectangular. Pedicle valve strongly convex, with a slight mesial flattening or depression, depressed toward the cardinal extremities. In the internal casts the hinge-line is apparently crenulate, the crenulations doubtless representing the bases of cardinal spines. A constricted line runs parallel to the front and lateral margins of the valve at a little distance from the margin, converging posteriorly to the beak; within this line the surface of the valve is somewhat elevated above the outer portion, the elevation being more conspicuous near the cardinal margin. Extending forward from the beak for about one-third of the length of the valve there is a low median septum represented by a shallow groove in the casts. The muscular scars are not well shown in any of the New Jersey specimens, but seem to resemble quite closely Hall's figures of this species. Brachial valve not observed.

The dimensions of an average specimen are: length, 15 mm.; width, 23 mm.; convexity, 5 mm.

Remarks.—Because of the apparent crenulations of the hinge-line in the internal casts of this species, the specimens resemble members of the genus *Stropheodonta,* but these crenulations doubtless represent the bases of cardinal spines. Internal casts of *C. arcuatus* from New York, illustrated by Hall, show similar crenulations. The constricted line in the internal casts is exactly as in the illustrations of typical specimens of *C. arcuatus,* and the muscular impressions are unlike any species of *Stropheodonta,* being closely similar, so far as they can be distinguished at all, to Hall's illustration of *C. arcuatus.*

SCHIZOPHORIA sp. cf. S. STRIATULA (Schl.).

Plate LII., Figs. 9–10.

Several imperfect internal casts of a species of *Schizophoria* have been collected at Newfoundland. They are all too poorly preserved for certain identification, but have the general form of *S. striatula* or *S. propinqua.* The pedicle valve, however, seems to be too depressed for the latter species, and they may be doubtfully referred to *S. striatula.*

growth. In the pedicle valve the dental lamellæ are united to form a spondylium, which is supported by a median septum, and in the internal casts these dental lamellæ and the median septum are represented by slits.

The dimensions of the best specimen observed, apparently a brachial valve, are: length, 40 mm.; width, 25 mm.; convexity, 7 mm.

Remarks.—This species has been recognized at both the Newfoundland and the Greenwood lake localities, always in the condition of imperfect internal casts, upon which the characters are always more or less obscure. There seems to be no other species, however, than *Amphigenia elongata* with which the specimens can be identified.

SPIRIFER MACROTHYRIS Hall.

Plate LII., Figs. 1–3.

1867. *Spirifer macrothyris* Hall, Pal. N. Y., vol. IV., p. 202, pl. 30, figs. 16–20.

Description.—Shell large, subelliptical in outline, much wider than long; hinge-line nearly equaling the greatest width; cardinal extremities angular or a little rounded. Pedicle valve moderately convex, with a well-defined, rather shallow, rounded, smooth mesial sinus; cardinal area of moderate width, a little concave, sharply defined and extending to the cardinal extremities; delthyrium large, broadly triangular. In the internal casts the muscular impression is large and prominent. Brachial valve more convex than the pedicle; mesial fold prominent, subangular posteriorly and rounded toward the front. Surface of each valve marked by from six to ten rather broad, depressed, rounded, simple plications on each side of the fold and sinus.

The dimensions of the largest specimen observed from New Jersey are: width, 98 mm.; estimated length of shell, 40 mm.

Remarks.—The only specimens of this species which have been observed are very imperfect, but they seem to possess characters which belong to no other *Spirifer* than *S. macrothyris*. Some of the smaller individuals from Newfoundland were at first thought to represent the Oriskany species, *S. murchisoni*, but the pedicle valves are less strongly convex and have less angular plications than that species, and they seem to agree essentially with the larger specimens, which exhibit more typically the characters of *S. macrothyris.*

SPIRIFER sp. undt.

Plate LII., Fig. 4.

Description.—A single, fairly well-preserved specimen of the brachial valve of a *Spirifer* has been observed from the Newfoundland locality which cannot be definitely identified with any of the described species. It is nearly semi-circular in outline, with the hinge-line equaling the greatest width and with angular cardinal extremities. The mesial fold is not greatly elevated above the general surface, and is marked along its median line by an angular furrow much deeper and wider than the furrows which separate the plications upon the lateral slopes of the valve. Each lateral slope is marked by eleven or twelve angular plications which become smaller and smaller toward the cardinal extremities.

The dimensions of the only specimen observed are: length, 16 mm.; width, 30 mm.

Remarks.—The peculiar feature of this species is the deep furrow along the mesial line of the fold. *Spirifer pennatus* Atw. frequently [redacted]

CYRTINA HAMILTONENSIS Hall.

Plate LII., Fig. 5.

1867. *Cyrtina hamiltonensis* Hall, Pal. N. Y., vol. IV., p. 268, pl. 27, figs. 1–4, pl. 44, figs. 26–33, 38–52.

Description.—Imperfect specimens of a species of *Cyrtina* occur at both the Newfounland and the Greenwood lake localities of this formation, which seem to be identical with *C. hamiltonensis.* The pedicle valve is subpyramidal in form, with a high, nearly-flat cardinal area, and in the internal casts a slit representing the median septum reaches from the beak more than half way to the front of the valve. The mesial sinus is well defined, smooth, rather shallow and rounded in the bottom, and on each lateral slope there are five or six simple, rounded plications. The brachial valve is depressed-convex, with the mesial fold flattened and but little elevated above the general surface of the valve; the plications upon the lateral slopes resemble those of the opposite valve.

The dimensions of the best pedicle valve observed are: length from beak to front margin, 9 mm.; width, 11 mm.; height of area, 5 mm.

Remarks.—The only specimens of this species which have been observed are imperfect internal casts, but they exhibit the characteristics of this common Devonian species.

ANOPLOTHECA ACUTIPLICATA (Con.).

See, also, pp. 370 and 383.

The specimens of this species in the Newfoundland grit do not differ materially from those found in the Onondaga limestone of the Delaware valley, except in being preserved in sandstone in the condition of internal casts. They somewhat resemble the Oriskany species, *A. flabellites*, but are constantly smaller.

MOLLUSCA.

PELECYPODA.

PTERINEA FLABELLA (Con.).

Plate LII., Fig. 12.

1884. *Pterinea flabella* Hall, Pal. N. Y., vol. V., pt. I., p. 93, pl. 14. figs. 1–21, pl. 15, figs. 1, 4–6, 8–10, pl. 83, figs. 11–12.

In the Newfoundland locality several imperfect specimens of a large species of *Pterinea* have been observed, which seem to represent the common Hamilton species, *P. flabella*, of New York. In none of the specimens can the complete form of the shell be observed, but the shell is oblique, with a broad and nearly-flat posterior wing, the anterior auriculation being destroyed in all of the specimens observed. The body portion of the left valve is subovate in outline and is marked with very coarse, rounded costæ, with alternate finer ones, besides indistinct, concentric lines of growth, these markings being identical with those of authentic specimens of *P. flabella* from the New York Hamilton shales. The height of the best-preserved specimen in the collection is about 40 mm.

terior auriculation convex, limited posteriorly by a distinct, broadly-rounded sinus, its anterior margin rounded; posterior wing large, nearly flat, rather sharply-defined by the posterior umbonal slope, its posterior margin concave and its posterior extremity angular. Surface of the left valve marked by moderately coarse, radiating costæ which alternate more or less irregularly with finer ones, the alternation being more conspicuous upon the posterior portion of the shell; also marked by concentric lines of growth, which give to the surface a reticulate appearance. Upon the wings the markings are less conspicuous than upon the body of the shell. Right valve not seen.

The dimensions of an average specimen are: height, 19 mm.; extreme length, 34 mm.

Remarks.—This species has been observed only in the Greenwood lake locality, where it occurs quite commonly. The specimens are all internal casts, so the surface markings are not so conspicuous as upon the external surface of the shell. The proportions and general form of the specimens seem to be most like authentic specimens of the New York Hamilton species, *A. decussata,* but none of the New Jersey specimens have been observed to attain as large a size as the larger individuals of that species, and the anterior auriculation is more conspicuous than is usually, but not always, the case in the New York specimens.

DESCRIPTIONS OF SPECIES IN THE FAUNAS OF THE MONROE SHALE AND BELLVALE FLAGS.

MOLLUSCOIDEA.

BRYOZOA.

FENESTELLA? sp. undet.

A few specimens of fenestelloid bryozoans have been collected from various localities in the Monroe shales of New Jersey, but none of them are in a proper state of preservation, even for accurate generic determination.

BRACHIOPODA.

ORTHOTHETES PANDORA (Bill.).

Plate LIII., Fig. 6.
See, also, pp. 367 and 373.

A few species of *Orthothetes* from Greenwood lake may be referred provisionally to the species *O. pandora.* The specimens are all imperfect and much distorted, so that in all of them the characters are more or less obscure.

CHONETES CORONATUS (Con.).?

Plate LIII., Fig. 5.

1867. *Chonetes coronata* Hall, Pal. N. Y., vol. IV., p. 133, pl. 21, figs. 9–12.

A few distorted specimens of a flat, subelliptical brachiopod shell, some of which seem to retain the bases of cardinal spines, may be referred with doubt to the species *Chonetes coronatus.* If the shell really possesses cardinal spines and is a true *Chonetes,* then its size and rather coarse, radiating markings correspond more closely with the characters of *C. coronatus* than with any other species of the genus.

angles to the hinge-line. Between this spine and the beak the bases of one or two additional spines may be detected. The characters of the shell are not well enough preserved to admit of its certain identification, and in the great length of the outer cardinal spines it seems to differ from any of the described species of the genus from the horizon to which it belongs.

CHONETES sp. undet.

An occasional small, imperfect and more or less distorted specimen of *Chonetes* is met with in the Monroe shales of New Jersey, which resembles more or less closely some of the smaller Hamilton species of the genus in New York, but none of them are perfect enough for certain identification.

CAMAROTOECHIA sp. undet.

Occasional specimens of Rhynchonelloid shells occur in the Monroe shales of New Jersey, which doubtless represent some of the New York Hamilton species of *Camarotœchia,* but none of the specimens can be identified with certainty. From the locality north of the Clinton reservor a single specimen seems to possess the general form and proportions of *C. sappho* Hall, but the identification cannot be made with certainty because of the imperfection of the specimen.

TROPIDOLEPTUS CARINATUS (Con.).

Plate LIII., Fig. 2.

1867. *Tropidoleptus carinatus* Hall, Pal. N. Y., vol. IV., p. 407, pl. 62, figs. 2–3.

Description.—The New Jersey specimens of this species are all distorted and imperfect, but some of them retain characteristic features of the species. The shell is normally concavo-convex, but in nearly all cases the New Jersey specimens are crushed perfectly flat; the outline is subsemi-elliptical, with the straight hinge-line equaling, greater or less than, the width of the shell; the cardinal extremities are rounded or subangular; the lateral margins are straight or convex, rarely a little concave just in front of the hinge-line; the anterior margin regularly rounded. Pedicle valve convex, broadly subcarinate along the mesial line, from which the surface slopes to the lateral margins with a flattened convex curve; beak small; cardinal area rather narrow, its margins subparallel. Brachial valve nearly flat, or slightly concave, often with a narrow mesial sinus which becomes more conspicuous anteriorly. Surface of each valve marked by from eighteen to twenty, broad, simple, rounded plications, the median one on the pedicle valve being broader and more elevated than the others, with a corresponding broader furrow along the median line of the brachial valve. The plications are crossed by fine, concentric striæ, and by a few stronger, imbricating, lamellose lines of growth.

The dimensions of the best of the New Jersey specimens are: length, 14 mm.; width, 11 mm.

Remarks.—The New Jersey specimens are all badly crushed and distorted, but some are sufficiently well-preserved to make the certain identification of the species possible.

SPIRIFER AUDACULUS (Con.).?

Plate LIII., Fig. 1.

1867. *Spirifer medialis* Hall, Pal. N. Y., vol. IV., p. 227, pl. 38, figs. 1-25, pl. 38*, figs. 1-11.

Description.—A few small, distorted, more or less imperfect speci-

AMBOCOELIA UMBONATA (Con.).

1867. *Ambocœlia umbonata* Hall, Pal. N. Y., vol. IV., p. 259, pl. 44, figs. 7–18.

Description.—Shell small, plano-convex, length and width nearly equal or a little wider than long; hinge-line a little shorter than the width of the shell; cardinal extremities rounded. Pedicle valve gibbous; the umbo elevated; the beak rather large and incurved; mesial sinus narrow, distinct from the beak to the front of the shell; cardinal area high, concave. Brachial valve depressed-convex or nearly flat, sometimes concave towards the front and lateral margins. Surface of both valves smooth or with a few concentric lines of growth near the margin.

The dimensions of the best specimen observed from New Jersey are: length, 3.5 mm.; width, 4.5 mm.

Remarks.—The only specimens of this species which have been observed in the New Jersey collections are from the fossil locality in the Monroe shales near the shore of Greenwood lake. They are not at all common, and are found only in the condition of internal casts, which are usually distorted and poorly preserved.

ANOPLOTHECA ACUTIPLICATA (Con.).?

Plate LIII., Fig. 3.
See, also, pp. 370 and 377.

The internal casts of what seems to be a species of *Anoplotheca* are among the commonest fossils found in the Monroe shales at the Greenwood lake locality. The specimens in this condition do not seem to differ materially from those found in the Newfoundland grit which have been identified as *A. acutiplicata.* All of the specimens are in an unsatisfactory condition for study, but this identification seems to be the correct one.

MOLLUSCA.

PELECYPODA.

ACTINOPTERIA sp. undet.

A few fragmentary specimens of Pelecypod shells which evidently belong to the genus *Actinopteria* have been observed in the Monroe shales. None of them are complete enough for specific identification, but they resemble, in general, the New York Hamilton members of the genus.

PALAEONEILO EMARGINATA (Con.).

Plate LIII., Figs. 10–11.

1885. *Palæoneilo emarginata* Hall, Pal. N. Y., vol. V., pt. I., p. 338, pl. 50, figs. 1–11.

Description.—"Shell of medium size or larger, subelliptical; length usually more than twice the height; basal margin gently curving or nearly straight from the post-inferior angle to the anterior end, where it is more abruptly rounded; posterior margin deeply sinuate. Cardinal line gently arcuate. Anterior end regularly and somewhat

Remarks.—The New Jersey specimens of this species have been observed only from the outlet of the Oak Ridge reservoir near Newfoundland. They possess the characteristic, regular, strong, lamelliform, concentric ridges and the deeply-emarginate, post-inferior extremity of the species, and the identification is more satisfactory than that of almost any other species collected from this horizon.

PARACYCLUS ELLIPTICA Hall.?

1885. *Paracyclus elliptica* Hall, Pal. N. Y., vol. V., pt. I., p. 440, pl. 72, figs. 23–33, pl. 95, fig. 18.

A single distorted and imperfect specimen of a pelecypod shell from the outlet of the Oak Ridge reservoir suggests *Paracyclus elliptica*, but the identification is necessarily uncertain.

GRAMMYSIA sp. undet.

Plate LIII., Figs. 8–9.

At the outlet to the Oak Ridge reservoir near Newfoundland several specimens of *Grammysia* have been collected. All of them are distorted, and are too imperfectly preserved for certain specific identification, but they possibly represent more than one species. Some of them resemble the illustrations of *G. alveata* (Con.),* but the identification cannot be made with certainty.

The members of this genus may be easily recognized by their robust form and by the coarse, concentric wrinkles of the shell. These New Jersey specimens are probably identical with some of the numerous forms which have been described from the Hamilton formation of New York.

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* Pal. N. Y., vol. V., pt. I., p. 370, pl. 60, figs. 1–11.

GASTROPODA.

CYRTONELLA MITELLA Hall.

Plate LIII., Fig. 12.

1879. *Cyrtolites* (*Cyrtonella*) *mitella* Hall, Pal. N. Y., vol. V., pt. II., p. 123, pl. 25, figs. 23–28.

Description.—"Shell arcuate, subovoid, making altogether less than two volutions in the same plane; first volution very minute; the body-whorl rapidly expanding to the aperture, which is nearly circular; the peristome scarcely spreading; the shell carinate, and the casts obtusely, but distinctly, angular on the dorsum; apparently not sinuate or but slightly undulated on the anterior margin. Surface marked by regular, sharply-elevated, subparallel, transverse striæ, which are comparatively distant (at least twice or thrice their width) near the apex and on the upper part of the outer volution, but become more crowded towards the front of the shell. On the upper part and sides of the shell the intermediate spaces are regularly cancellated by short, revolving striæ, which hardly rise so high as the transverse ones, giving the entire surface a pitted or finely-reticulate character. Approaching the margin the spaces between these striæ diminish, as the result of the rate of growth in the shell, and they often become so crowded as to present the character of simple, undulating, granulose lines of

STROPHOSTYLUS? sp. undet.

Plate LIII., Figs. 13–16.

Among the specimens collected from the Monroe shales of New Jersey there are several imperfect and distorted coiled shells, which are probably referable to the genus *Strophostylus*. In none of them are the characters sufficiently well-preserved for specific identification, and even the generic reference must be considered doubtful.

ARTHROPODA.

TRILOBITA.

HOMALONOTUS DEKAYI (Green).

1888. *Homalonotus Dekayi* Hall and Clarke, Pal. N. Y., vol. VII., p. 7, pl. 2, figs. 1–11, pl. 3, figs. 1–5, pl. 4, figs. 1–6, pl. 5, figs. 1–10.

At Sylvester's Corners a single thoracic segment of a trilobite has been found in the Monroe shales, which is evidently a portion of a species of *Homalonotus*, and is probably the common New York Hamilton species of the genus, *H. dekayi*.

PHACOPS RANA (Green).

Plate LIII., Fig. 18.

1888. *Phacops rana* Hall and Clarke, Pal. N. Y., vol. VII., p. 19, pl. 7, figs. 1–11, pl. 8, figs. 1–18, pl. 8 *A*, 21–33.

Imperfect and distorted specimens of the head of this species have been found in some of the localities of the Monroe shale in New Jersey. The species may be recognized by its large and broad glabella without lateral furows. The specimen here illustrated is the best one which has been observed, and it exhibits the characters of the species as well as they can be seen in any New Jersey specimen so far collected. The thorax and pygiduim have not been observed.

DALMANITES sp. cf. D. ANCHIOPS (Green).

Plate LIII., Fig. 17.

1888. *Dalmanites* (*Chasmops*) *anchiops* Hall and Clarke, Pal. N. Y., vol. VII., p. 59, pl. 9, figs. 1–6, 10, 12–13, pl. 10, figs. 1–14.

A single specimen of the pygidium of a large species of *Dalmanites* has been collected at the Greenwood lake locality in the Monroe shale. It is imperfect and distorted, but seems to resemble *D. anchiops* more closely than any other species. The axis tapers rather gradually and is divided into fifteen or sixteen segments. The pluræ are flattened and are marked by about twelve segments. The terminal spine of the pygidium is not preserved in the New Jersey specimen, but its posterior extremity is imperfect and the spine may have been destroyed. The specimen is in such a condition of preservation that this identification can in all events be considered only as provisional.

Plates and Explanations.

(All Figures Are Natural Size, Unless Otherwise Indicated).

PLATE I.

PAGE.

FORAMINIFERA? 111

Figs. 1–2. Two specimens. *Newton, Locality 136 A.*

ORTHIS NEWTONENSIS n. sp. 113

Fig. 3. The internal cast of a pedicle valve, showing the muscular scar. *Locality 136 A.* (x 2).

4. A similar, but larger pedicle valve. *Same locality.* (x 2).

5. The internal cast of a brachial valve. *Same locality.* (x 2).

LINGULELLA STONEANA Whitf. 112

Fig. 6. A nearly perfect single valve, showing the peculiar surface markings. *Newton, Locality 136 A.* (x 2).

AGRAULOS SARATOGENSIS Walc. 118

Fig. 7. A large, nearly complete cranidium, with profile in outline. *Blairstown, Locality 175 A.*

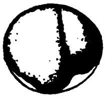
8. A large free cheek. *Same locality.*

9. A medium-sized pygidium. *Same locality.*

PTYCHOPARIA BLAIRI n. sp. 116

Figs. 10–11. Two cranidia of average size. *Blairstown, Locality 175 A.* (x 5).

12. Profile view of cranidium, in outline. (x 5).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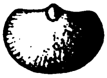
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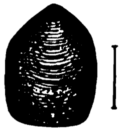
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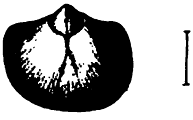
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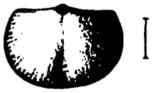
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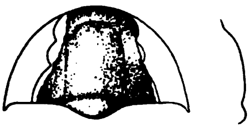
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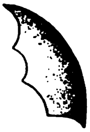
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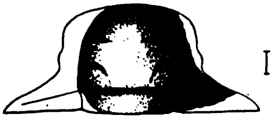
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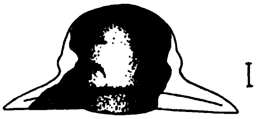
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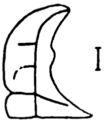
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CAMBRIAN.

PLATE II.

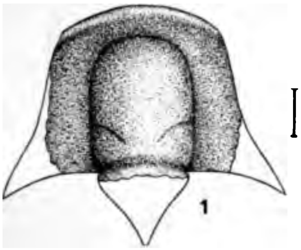
PAGE.

SOLENOPLEURA JERSEYENSIS Weller.................. 119

Figs. 1–6. Dorsal and lateral views of three cranidia. *Carpentersville, Locality 341 A.* (x 5).
7. Dorsal view of an incomplete pygidium. *Same locality.* (x 4).
8. Transverse outline of the same.

OLENELLUS THOMPSONI (Hall)...................... 114

Figs. 9–10. Dorsal views of two cranidia. *Franklin Furnace.*



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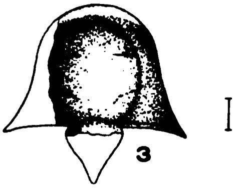

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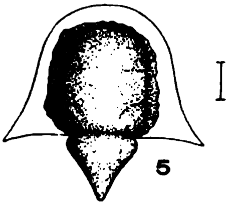

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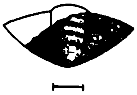

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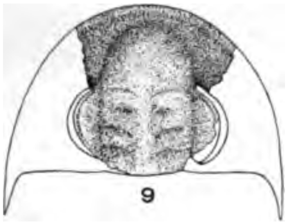

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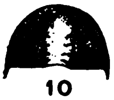

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CAMBRIAN.

PLATE III.

PAGE.

DIKELOCEPHALUS NEWTONENSIS n. sp. 121

Fig. 1. Dorsal view of a nearly complete cranidium, with the profile in outline. *Newton, Locality 136 A.*

2. Dorsal view of a cranidium, with free cheek attached. *Same locality.*

3. Dorsal view of a small pygidium, with profile in outline. *Same locality.*

4. Dorsal view of a large, imperfect pygidium. *Same locality.*

5–7. Dorsal views of three more or less incomplete free cheeks, probably belonging to this species. *Same locality.*

OLENELLUS? sp. undet. 115

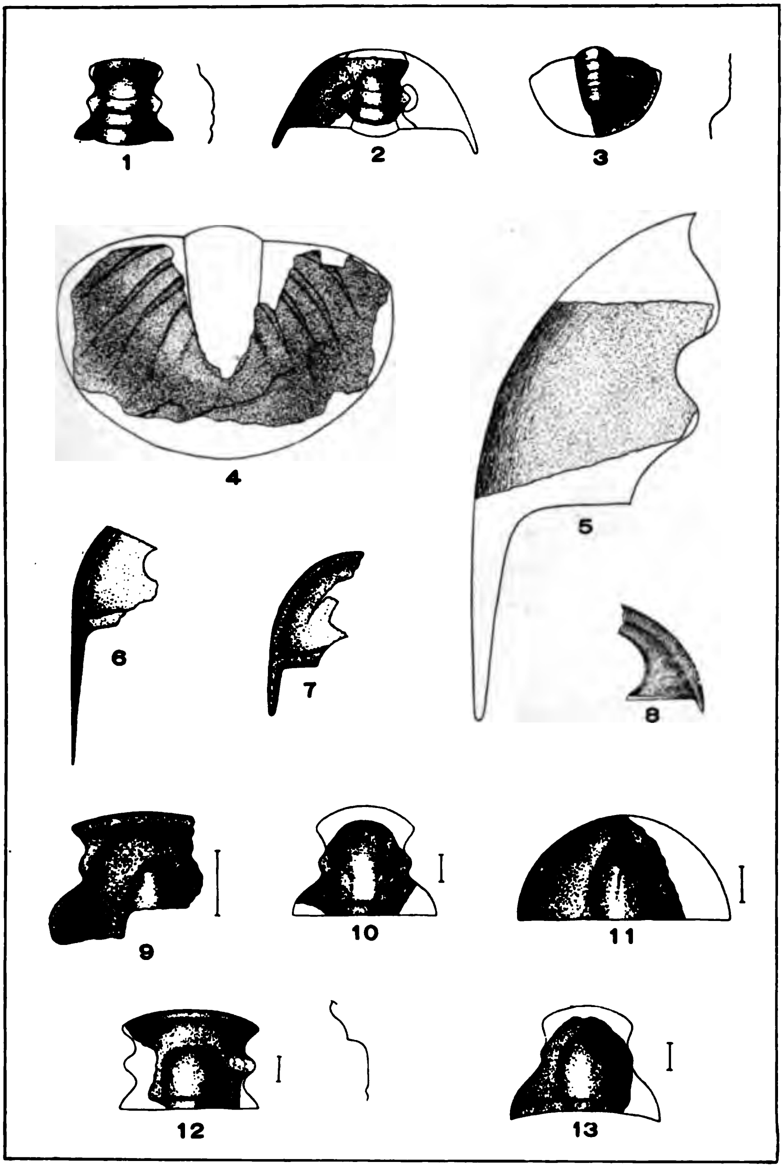
Fig. 8. An imperfect free cheek. *Newton, Locality 136 A.*

PTYCHOPARIA sp. undet. 118

Fig. 9. Dorsal view of an imperfect cranidium. *Newton, Locality 136 A.* (x 2).

PTYCHOPARIA NEWTONENSIS n. sp. 117

Fig. 10. Dorsal view of a cranidium. *Newton, Locality 136 A.* (x 4).



CAMBRIAN.

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POLYGYRATA SINISTRA n. sp. 130

Figs. 1–2. Vertical and profile views in outline. *Columbia, Locality 210 A.*

RAPHISTOMA COLUMBIANA n. sp. 128

Figs. 3–4. Vertical and profile views of the type specimen. *Columbia, Locality 210 A.*

5. Cross-section of the peripheral angle, showing the thickening of the shell. (Enlarged.)

ECCYLIOMPHALUS SUBELLIPTICA n. sp. 129

Fig. 6. View of the type specimen. *Columbia, Locality 210 A.*

CYRTOLITES SINUATUS H. & W. 127

Fig. 9. Lateral view of outer volution, with cross-section in outline. *Columbia, Locality 210 A.*

DALMANELLA WEMPLEI Cleland 124

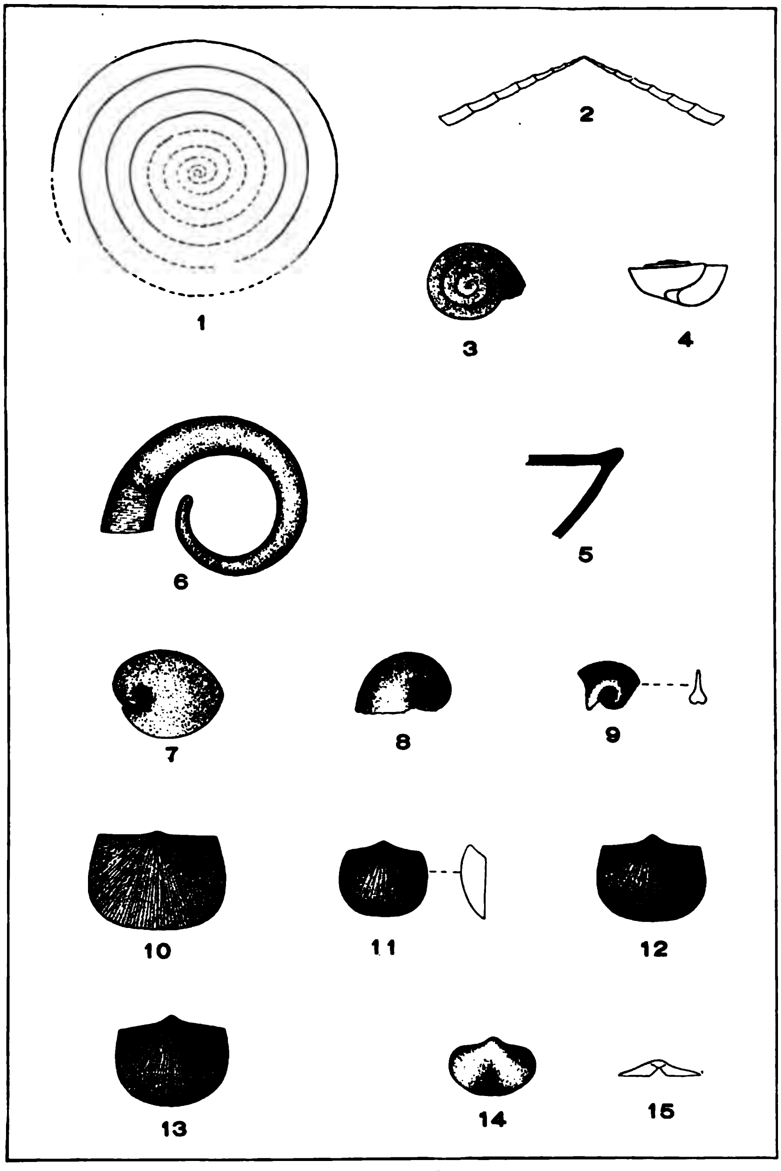

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PLATE V.

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ILLAENURUS COLUMBIANA n. sp........................ 133

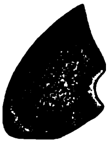
Fig. 1. A free cheek. *Columbia, Locality 210 A.*
2-3. Dorsal view and profile in outline of a large cranidium. *Same locality.*
4. A perfect pygidium. *Same locality.*

ISOTELUS CANALIS (Whitf.)......................... 132

Fig. 5. Cephalon restored in outline from an incomplete free cheek. *Columbia, Locality 210 A.*
6. Pygidium restored in outline. *Same locality.*

CYRTOCERAS sp. undet.............................. 131

Fig. 7. Lateral view of a weathered specimen, showing the septa and the slightly-curved shell. *Columbia, Locality 210 A.*



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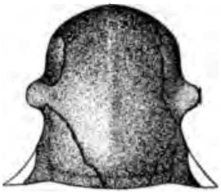

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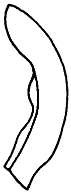

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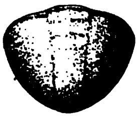

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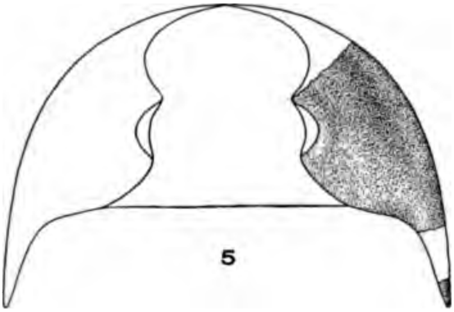

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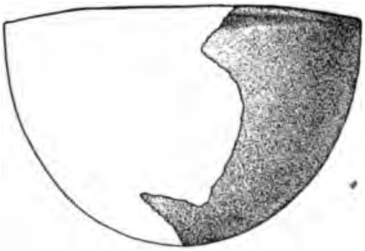

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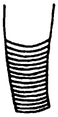

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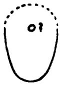

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BEEKMANTOWN.

PLATE VI.

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HINDIA PARVA Ulrich............................... **135**

Fig. 1. A specimen of rather large size. ***Jacksonburg, Locality 17½ A.***[18]

RECEPTACULITES OCCIDENTALIS Salt.................... **135**

Fig. 2. Weathered section of a nearly complete, subcircular specimen. ***Near Stillwater, Locality 153 A.***

3. Weathered surface, showing the arrangement of the terminations of the spicules. ***Near Springdale, Locality 156 A.***

4. Weathered surface with projecting spicules, the condition in which the species usually occurs. Same specimen as last.

ROMINGERIA? TRENTONENSIS n. sp.................... **138**

Fig. 5. A weathered specimen partially restored. ***Near Stillwater, Locality 153 B.***

STREPTELASMA CORNICULUM Hall................. **136**

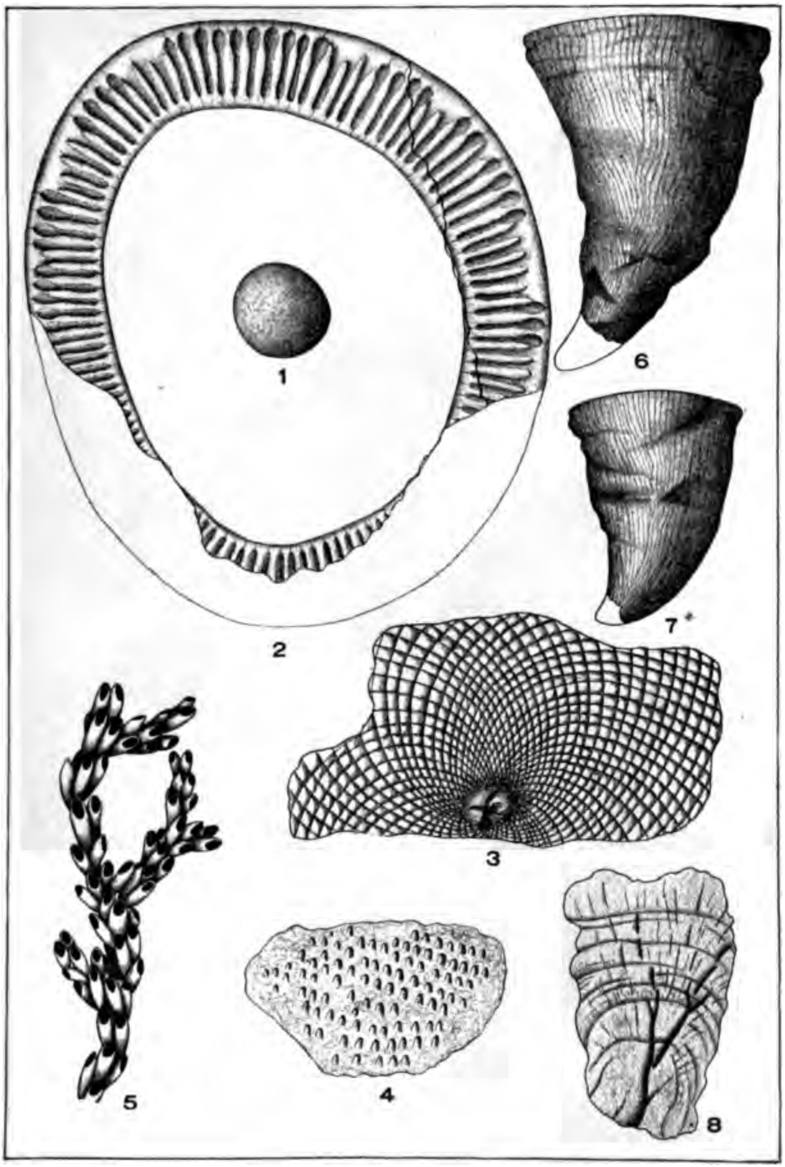

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PLATE VII.

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NYCTOPORA BILLINGSI Nich. **137**

Figs. 1-2. **Transverse and vertical sections of the species.** ***Jacksonburg, Locality 174 A.*** **(x 5).**

ACTINOSTROMA TRENTONENSIS n. sp. **139**

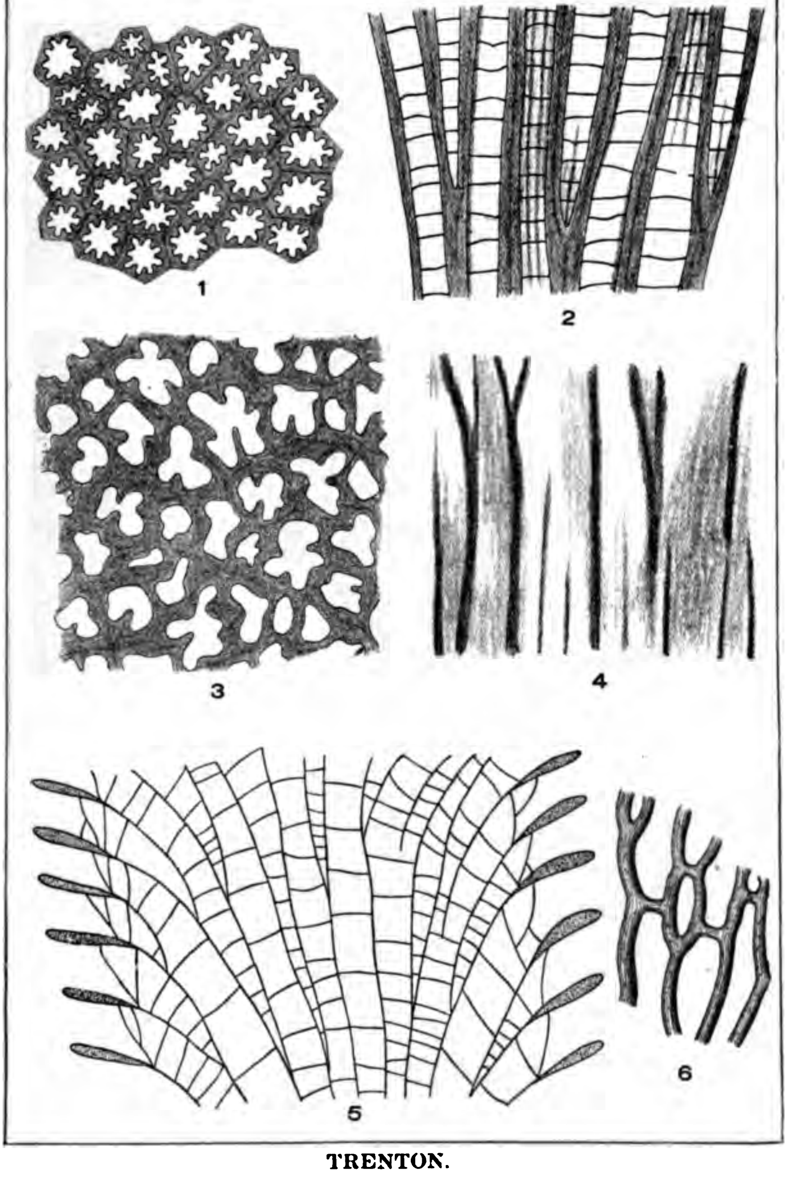
Figs. 3-4. **Transverse and vertical sections of the species, showing the minute structure. (x 45).**

CALLOPORA sp. undet. **142**

Fig. 5. **Longitudinal section of a specimen.** ***Near Beaver Run, Locality 79 A.*** **(x 24).**

PHYLLOPORINA FENESTRATA (Hall) **143**

Fig. 6. **Obverse side of a specimen.** ***Near Beaver Run, Locality 79 A.*** **(x 4).**



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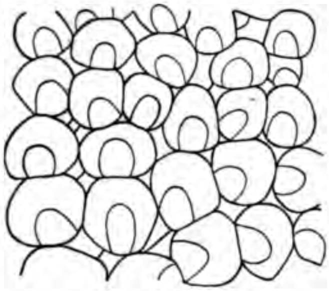
PRASOPORA SIMULATRIX Ulrich........................ 140

Figs. 1–2. Tangential and longitudinal sections. (x 24).
3. Section through a depressed-hemispherical zoarium. *Jacksonburg, Locality 174 A.*

MONOTRYPA GLOBOSA n. sp............................ 142

Figs. 4–5. Tangential and longitudinal sections. *Near Beaver Run, Locality 79 A.* (x 24).
6. Section through a subglobular zoarium. *Same locality.*

RHINIDICTYA sp. undet............................... 143



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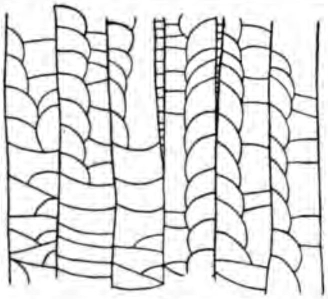

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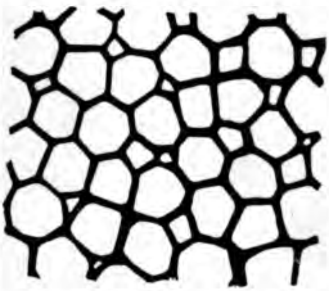

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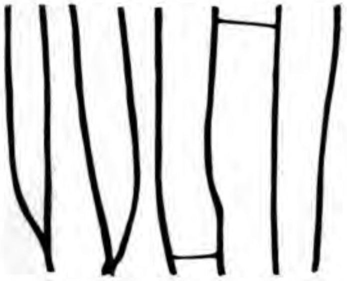

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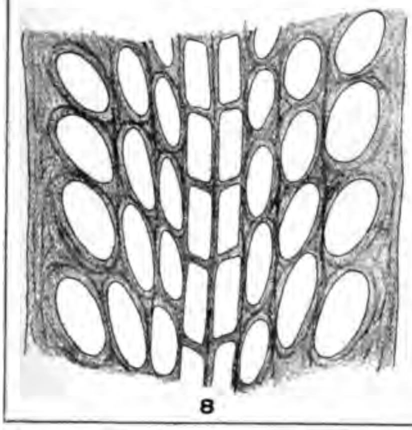

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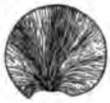

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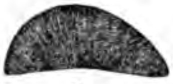

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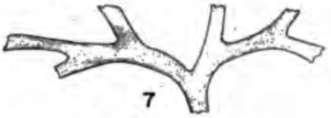

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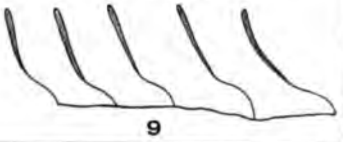

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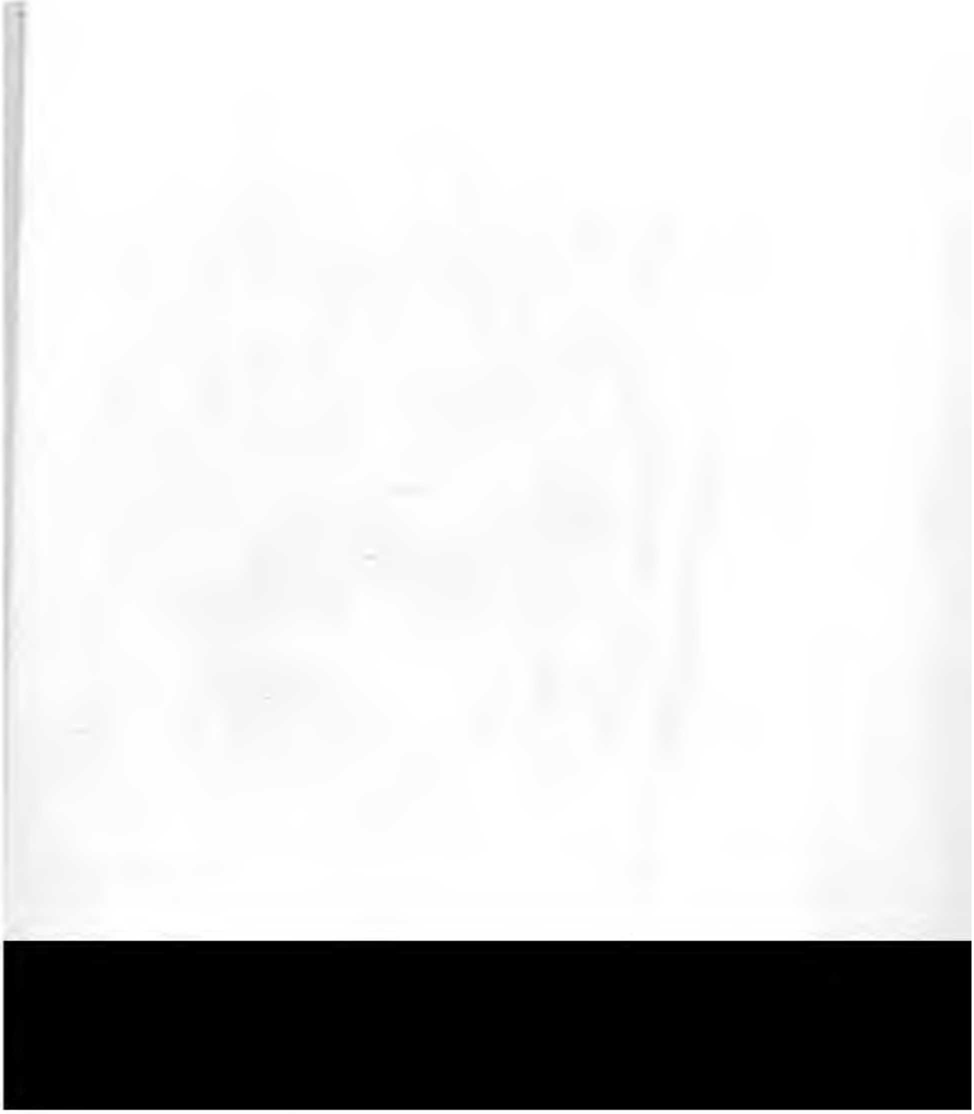

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ORBICULOIDEA LAMELLOSA (Hall) 147

Figs. 1–2. Vertical and lateral views of a nearly perfect brachial valve. *Jacksonburg, Locality 174 A.*[40] (x 2).

SCHIZOCRANIA FILOSA (Hall) 146

Figs. 3–4. Vertical views of two brachial valves. *Jacksonburg, Locality 174 A.*

ORBICULOIDEA? sp. undet 147

Figs. 5–6. Vertical and lateral views of an imperfect brachial valve. *Near Branchville, Locality 75 A.*

LINGULA PHILOMELA Bill.? 145

Fig. 7. An incomplete valve. *Near Beaver Run, Locality 79 A.*

LINGULA RICINIFORMIS Hall 144

Fig. 8. A nearly perfect valve, partially exfoliated. *Jacksonburg, Locality 174 A.*[38] (x 2).

CRANIA sp. undet 148

Fig. 9. A complete brachial valve. *Near Beaver Run, Locality 79 A.*

LINGULASMA GALENENSIS W. & S. 145

Figs. 10–11. Vertical and lateral views of the internal cast of a brachial valve. *Drake's Pond, near Newton, Locality 136 B.*

RAFINESQUINA ALTERNATA (Emm.) 148

Fig. 12. View of a nearly complete pedicle valve. *Jacksonburg, Locality 174 A.*

13. Profile of the same specimen in outline.

PLECTAMBONITES SERICEUS (Sow.) 149

Fig. 14. A nearly perfect, large pedicle valve. *Near Beaver Run, Locality 79 A.*

15. A brachial valve. *Jacksonburg, Locality 174 A.*

STROPHOMENA INCURVATA (Shep.) 150

Fig. 16. An imperfect brachial valve. *Jacksonburg, Locality 174 A.*

17. A small pedicle valve. *Same locality.*

ORTHIS TRICENARIA Conrad 151

Figs. 18–21. Brachial, lateral, pedicle and posterior views of a nearly perfect specimen. *Jacksonburg, Locality 174 A.*[37]

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Figs. 22–24. Pedicle, lateral and anterior views of a nearly complete specimen. *Near Beaver Run, Locality 79 A.*

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PLATYSTROPHIA BIFORATA (Schl.) **153**

Figs. 25–28. Brachial, pedicle, lateral and anterior views of a complete specimen. *Near Beaver Run, Locality 79 A.*

DINORTHIS PECTINELLA (Emm.) **154**

Fig. 29. A pedicle valve. *Drake's Pond, near Newton, Locality 136 B.*
30. A brachial valve. *Same locality.*

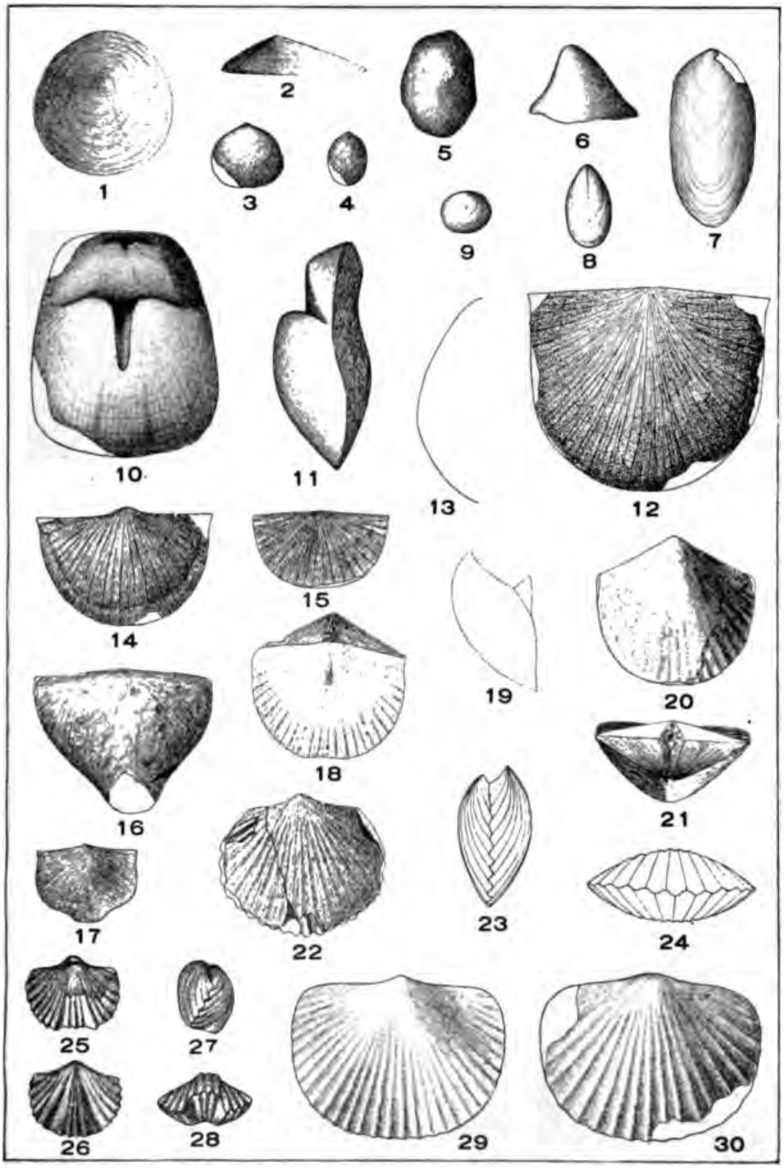
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PLATE X.

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DALMANELLA TESTUDINARIA (Dal.) **155**

Fig. 1. A pedicle valve. *Jacksonburg, Locality 174 A.* (x 2).
2. A brachial valve. *Jacksonburg, Locality 174 A.* (x 2).

DALMANELLA SUBAEQUATA (Con.) **156**

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SCENIDIUM ANTHONENSIS Sard. **157**

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6. A nearly complete pedicle valve. *Same locality.* (x 2).
7. Profile of the same in outline. (x 2).

CAMARELLA INORNATA n. sp. **157**

Figs. 8–10. Pedicle, brachial and lateral views of a complete, large specimen. *Hainesburg, Locality 192 A.*

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Figs. 11–14. Brachial, pedicle, anterior and lateral views of a complete specimen. *Drake's Pond, near Newton, Locality 136 B.*

RHYNCHOTREMA INAEQUIVALVIS (Castel.) **159**

Figs. 15–18. Brachial, pedicle, anterior and lateral views of a complete specimen. *Jacksonburg, Locality 174 A.*

RHYNCHOTREMA DENTATA (Hall) **159**

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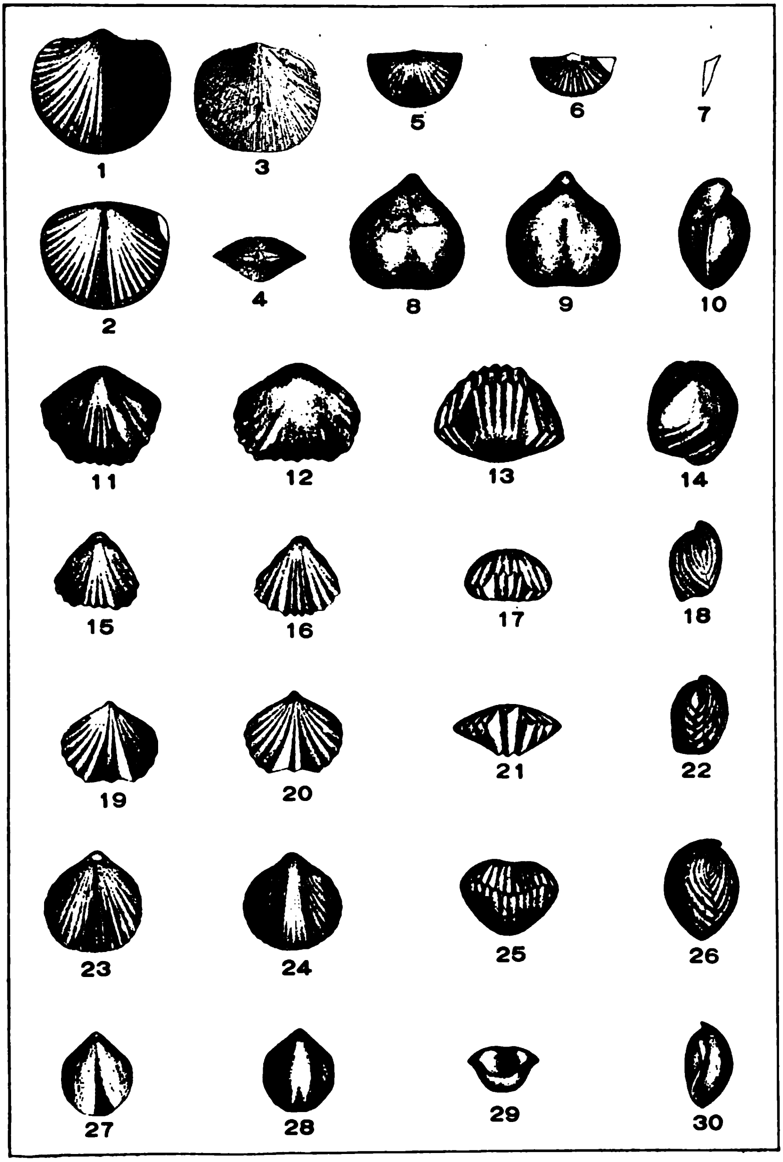

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PLATE XI.

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Fig. 1. The internal cast of a large right valve. *Near Iliff's Pond, Locality 137 A.*[1]

WHITELLA SUBORBICULARIS n. sp...................... 168

Fig. 2. A nearly complete left valve. *Jacksonburg, Locality 174 A.*

CYRTODONTA CANADENSIS Bill........................ 167

Fig. 3. An incomplete right valve. *Jacksonburg, Locality 174 A.*[17]

WHITELLA SUBTRUNCATA (Hall)...................... 169

Fig. 4. A nearly complete right valve. *Jacksonburg, Locality 174 A.*[49]

ORTHODESMA CANALICULATUM Ulrich.................. 171

Fig. 5. View of the right side of a nearly complete internal cast. *Jacksonburg, Locality 174 A.*[49]

CUNEAMYA TRUNCATULA Ulrich....................... 162

Fig. 6. A nearly complete right valve. *Jacksonburg, Locality 174 A.*

CYRTODONTA BILLINGSI Ulrich 166

Fig. 7. View of the right valve of a nearly complete specimen. *Drake's Pond, Near Newton, Locality 136 B.*

MODIOLOPSIS DEPRESSA n. sp......................... 171

Fig. 8. A complete right valve. *Jacksonburg, Locality 174 A.*[41]

MODIOLOPSIS JERSEYENSIS n. sp...................... 170

Fig. 9. A complete right valve. *Jacksonburg, Locality 174 A.*[2]

MODIOLOPSIS sp. undet.............................

Figs. 10–11. Two right valves. *Jacksonburg, Locality 174 A.*[5]

MODIOLOPSIS sp. undet.............................

Fig. 12. A small left valve, possibly *M. jerseyensis. Jacksonburg, Locality 174 A.*[9]

MODIOLOPSIS FABA (Con.)........................... 169

Fig. 13. A right valve. *Jacksonburg, Locality 174 A.*
14. A left valve. *Same locality.*
15. Another right valve. *Same locality.*

CLIDOPHORUS NEGLECTUS Hall....................... 165

Fig. 16. A left valve. *Jacksonburg, Locality 174 A.*[50]

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CTENODONTA JERSEYENSIS n. sp. 164

Fig. 17. A complete right valve. *Jacksonburg, Locality 174 A.*[1]

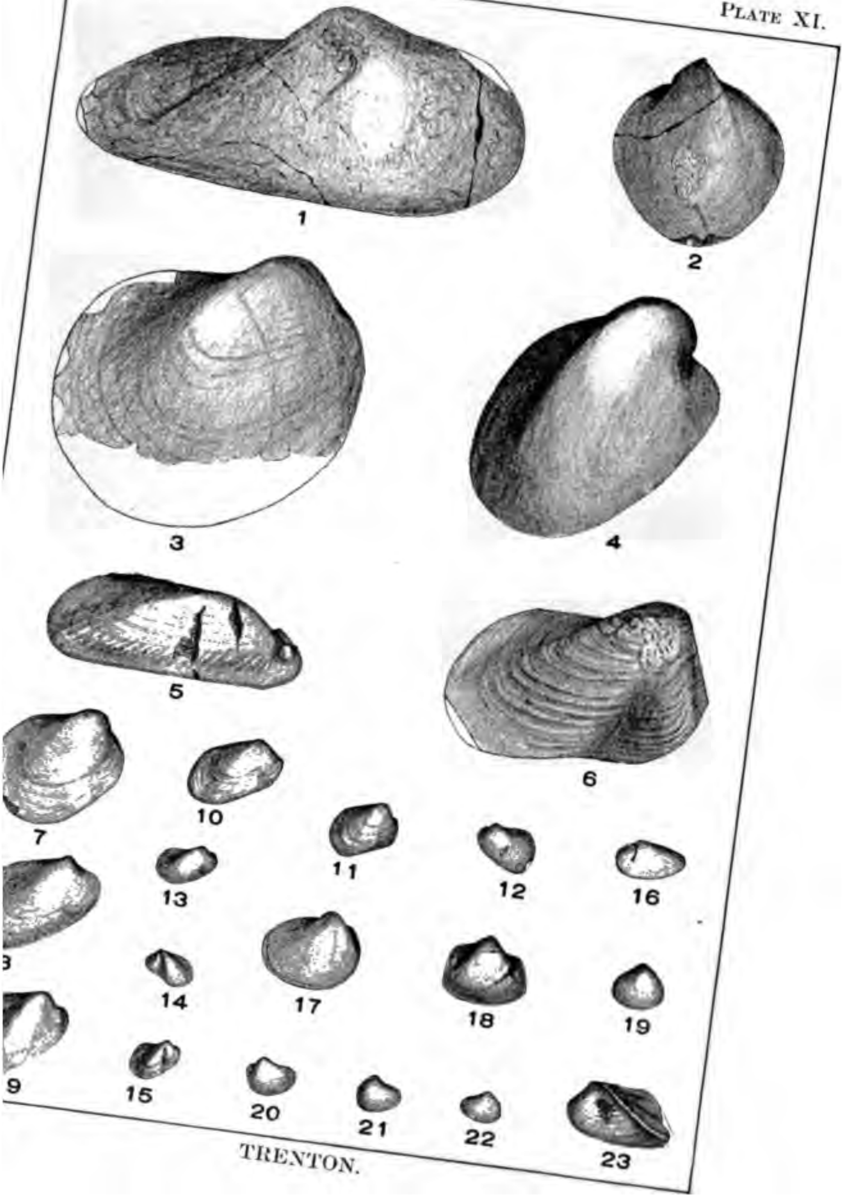
CTENODONTA LEVATA (Hall) 165

Figs. 18–22. Views of several specimens referred to this species provisionally. *Jacksonburg, Locality 174 A.*

GONIOPHORA CARINATUS (Hall) 173

Fig. 23. A nearly complete left valve. *Jacksonburg, Locality 174 A.*[40]

PLATE XI.



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ARCHINACELLA PATELLIFORMIS (Hall)................. 174

Figs. 1–2. A dorsal and a lateral view of a nearly complete specimen. *Jacksonburg, Locality 174 A.*

PROTOWARTHIA CANCELLATA (Hall)................... 175

Fig. 3. Dorsal view of a large specimen, showing the transverse wrinkles near the aperture. *Jacksonburg, Locality 174 A.*

Figs. 4–5. Dorsal and lateral views of a smaller, nearly complete specimen. *Same locality.*

CYRTOLITES ORNATUS var. MINOR U. & S............... 174

Figs. 6–7. Dorsal and lateral views of an incomplete specimen. *Jacksonburg, Locality 174 A.*[52]

OXYDISCUS SUBACUTUS Ulrich........................ 179

Figs. 8–9. Two views of an incomplete specimen. *Near Springdale, Locality 156 A.*

BUCANIA PUNCTIFRONS (Emm.)...................... 177

Fig. 10. Lateral view of an average-sized specimen. *Jacksonburg, Locality 174 A.*[62]

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ECCYLIOMPHALUS CONTIGUUS Ulrich.................. 185

Figs. 13–15. Three views of a complete specimen. *Jacksonburg, Locality 174 A.*

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Figs. 16, 17. Two views of an incomplete, somewhat distorted specimen. *Jacksonburg, Locality 174 A.*

TETRANOTA BIDORSATA (Hall)....................... 176

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ECCYLIOMPHALUS TRENTONENSIS (Con.)............... 184

Figs. 20, 21. Two views of an incomplete specimen. *Jacksonburg, Locality 174 A.*

RAPHISTOMA PERACUTUM U. & S...................... 180

Figs. 22, 23. Two views of an incomplete specimen. *Jacksonburg, Locality 174 A.*[10]

LIOSPIRA MICULA (Hall)........................... 182

Figs. 24, 25. Two views of a nearly complete specimen. *Jacksonburg, Locality 174 A.*

PLATE XII.—(*Continued.*)

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Figs. 26, 27. Lateral views of two incomplete specimens. ***Jacksonburg, Locality 174 A.***

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Fig. 28. Lateral view of a nearly complete specimen. ***Jacksonburg, Locality 174 A.***

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Fig. 29. Lateral view of an incomplete internal cast. ***Jacksonburg, Locality 174 A.***

HOLOPEA PARVULA Ulrich............................ 187

Fig. 30. Lateral view of a nearly complete specimen, a partial internal cast. ***Jacksonburg, Locality 174 A.***

HOLOPEA SUPRAPLANA U. & S.?...................... 187

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Fig. 33. Lateral view of an incomplete specimen. ***Near Branchville, Locality 75 A.***

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Fig. 34. Lateral view of an incomplete specimen. ***Jacksonburg, Locality 174 A.***[10]

PTEROTHECA EXPANSA (Emm.)?...................... 179

Fig. 35. Dorsal view of a fragmentary specimen. ***Jacksonburg, Locality 174 A.***

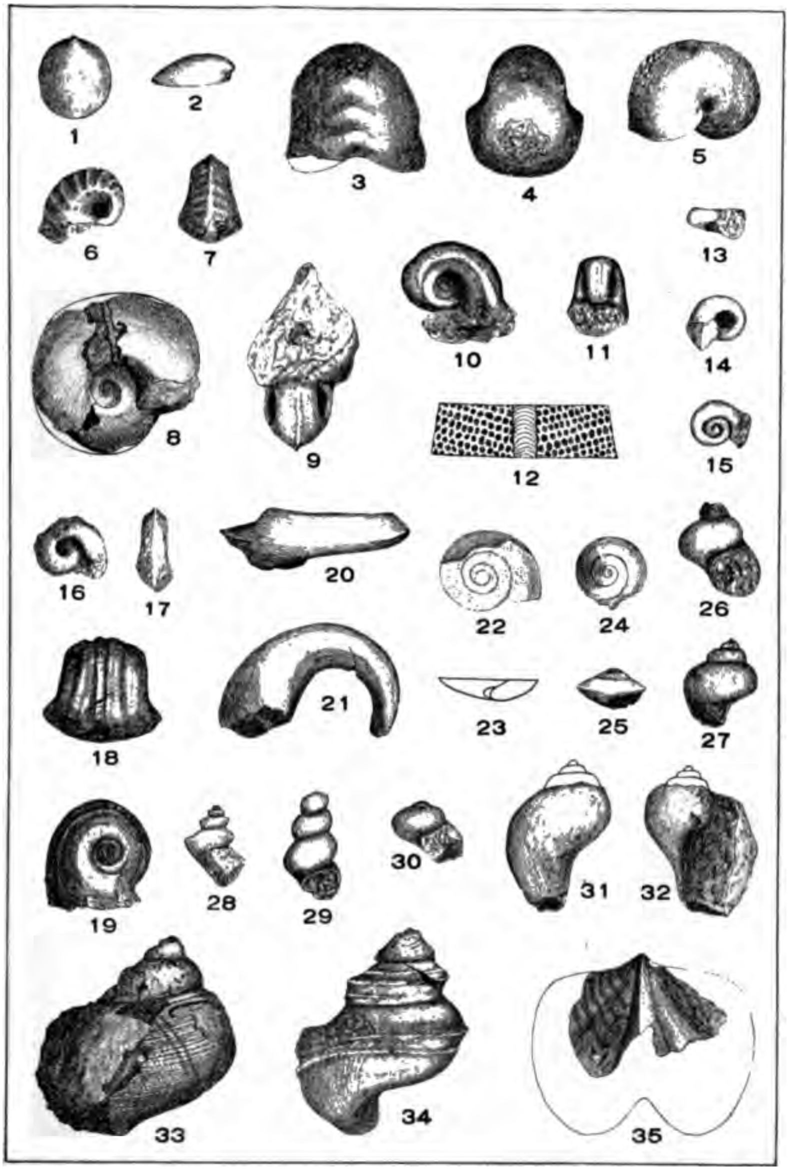
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PLATE XIII.

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ORTHOCERAS TENUISTRIATUM (Hall).................. 188

Fig. 1. A large specimen, showing the longitudinal banding of the shell. *Jacksonburg, Locality 174 A.*[30]

2. A small fragment, showing the transverse markings of the shell.

ORTHOCERAS TENUITEXTUM (Hall).................... 189

Fig. 3. Lateral view of an incomplete specimen retaining the delicate surface markings. *Jacksonburg, Locality 174 A.*

4. Surface markings of the same, much enlarged.

CAMEROCERAS PROTEIFORME (Hall).................... 190

Fig. 5. A fragment of a small siphonal cast. *Near Springdale, Locality 156 A.*

ORTHOCERAS sp. undet................................ 190

Fig. 6. *Jacksonburg, Locality 174 A.*

CONULARIA TRENTONENSIS Hall........................ 188

Fig. 7. A nearly complete specimen. *Jacksonburg, Locality 174 A.*[33]

8. Surface markings of the same, much enlarged.

CHITON? sp. 173

Figs. 9, 10. Two views of the only specimen observed. *Jacksonburg, Locality 174 A.*[4]

LEPERDITIA FABULITES (Con.)......................... 208

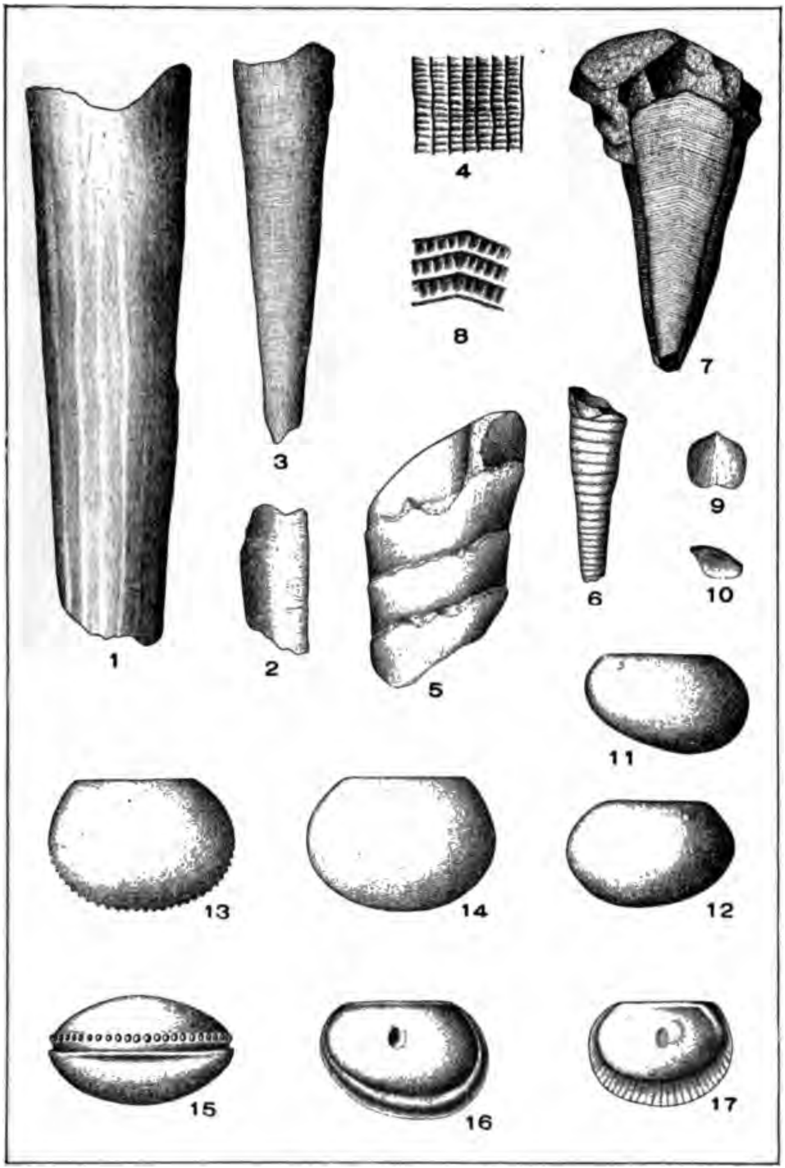

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PLATE XIV.

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HARPINA OTTAWENSIS (Bill.) 191

Fig. 1. Dorsal view of an incomplete head. *Jacksonburg, Locality 174 A.*
2. Impression of the marginal border of the head. *Same locality.*

TRINUCLEUS CONCENTRICUS (Eaton) 192

Figs. 3, 4. Dorsal and anterior views of a nearly complete head. *Jacksonburg, Locality 174 A.*[32]

ISOTELUS GIGAS De Kay 192

Fig. 5. A small, complete individual (after Clarke).
6. A small, incomplete pygidium. *Jacksonburg, Locality 174 A.*
7. A large, nearly complete free cheek. *Near Beaver Run, Locality 79 A.*

BUMASTUS TRENTONENSIS (Emm.) 194

Fig. 8. A nearly complete individual with the head crowded out of place. *Jacksonburg, Locality 174 A.*[57]
9. A complete cranidium, partially exfoliated. *Same locality.*
10. A larger, incomplete cranidium. *Jacksonburg, Locality 174 A.*
11. A nearly complete pygidium. *Jacksonburg, Locality 174 A.*[57]
12. A small, complete pygidium. *Near Iliff's Pond, Locality 137 A.*[1]
13. A complete free cheek. *Jacksonburg, Locality 174 A.*[57]

BUMASTUS TRANSVERSALIS n. sp. 195

Fig. 14. The cranidium and pygidium of an individual, with fragments of the thoracic segments. *Hainesburg, Locality 192 A.*

BUMASTUS ELONGATUS n. sp. 195

Fig. 15. A complete pygidium, slightly distorted. *Near Springdale, Locality 156 A.*

PTYCHOPYGE JERSEYENSIS n. sp. 193

Fig. 16. An incomplete pygidium. *Jacksonburg, Locality 174 A.*[6]

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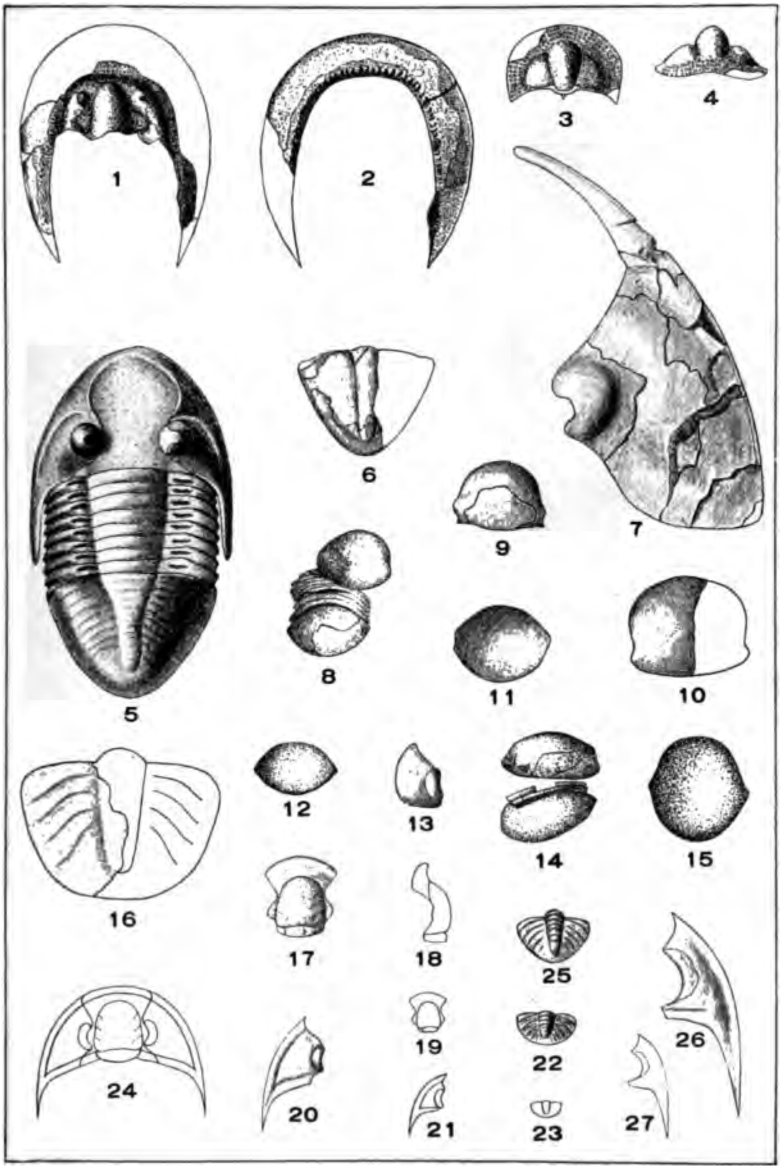
	PROETUS LATIMARGINATUS n. sp.	195

Figs. 17, 18. Dorsal and lateral views of a nearly complete cranidium. *Jacksonburg, Locality 17¼ A.* (x 2).
19. Dorsal view of the same, natural size.
20. A complete free cheek. *Same locality.* (x 2).
21. The same. Natural size.
22. A complete pygidium. *Jacksonburg, Locality 17¼ A.*[38] (x 2).
23. The same. Natural size.
24. Restoration in outline of the complete head. (x 2).
25. A large pygidium which doubtfully belongs to this species.

PTERYGOMETOPUS? sp. undet. ....

Fig. 26. An incomplete free cheek, differing from other representatives of this genus in its elongate genal spine. *Jacksonburg, Locality 17¼ A.*[13] (x2).
27. The same. Natural size.



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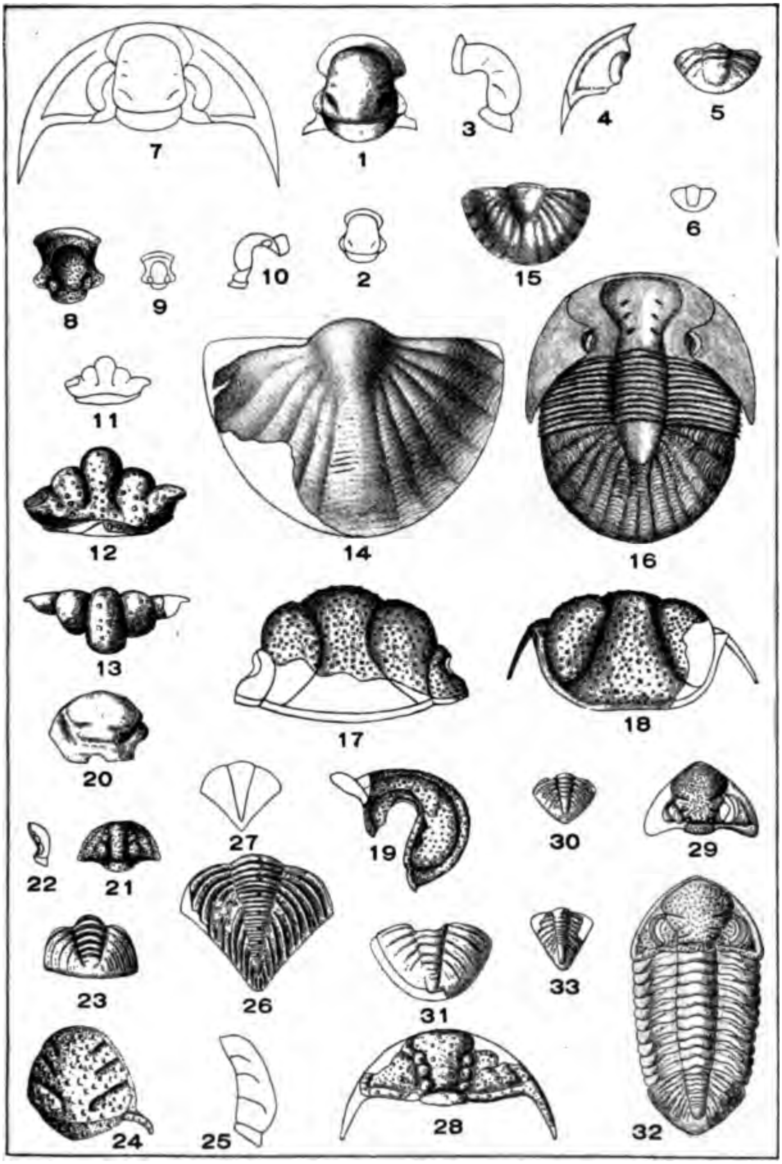
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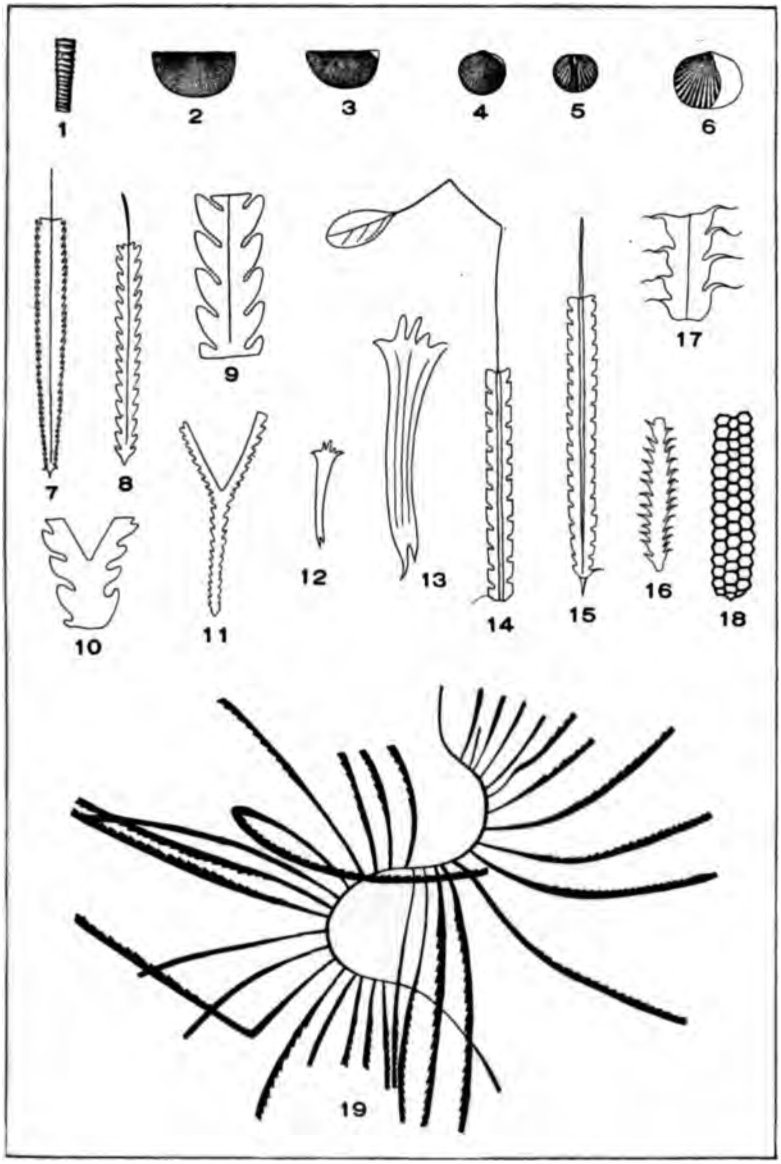

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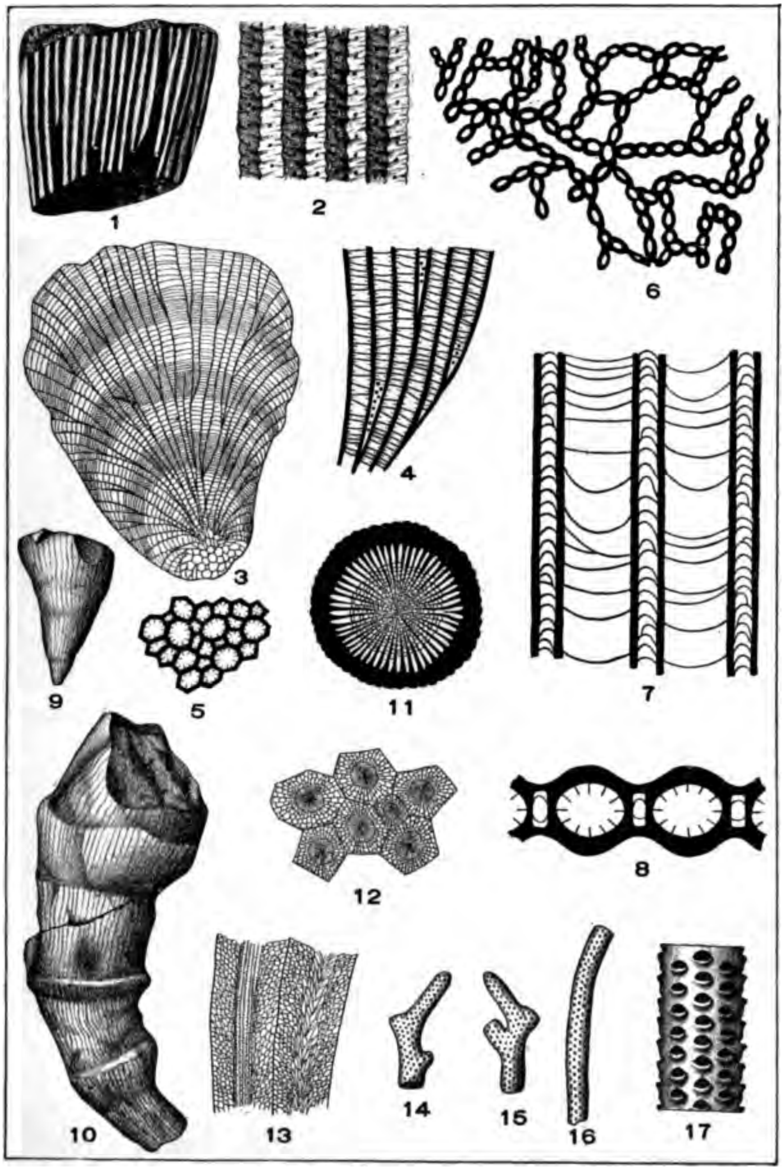

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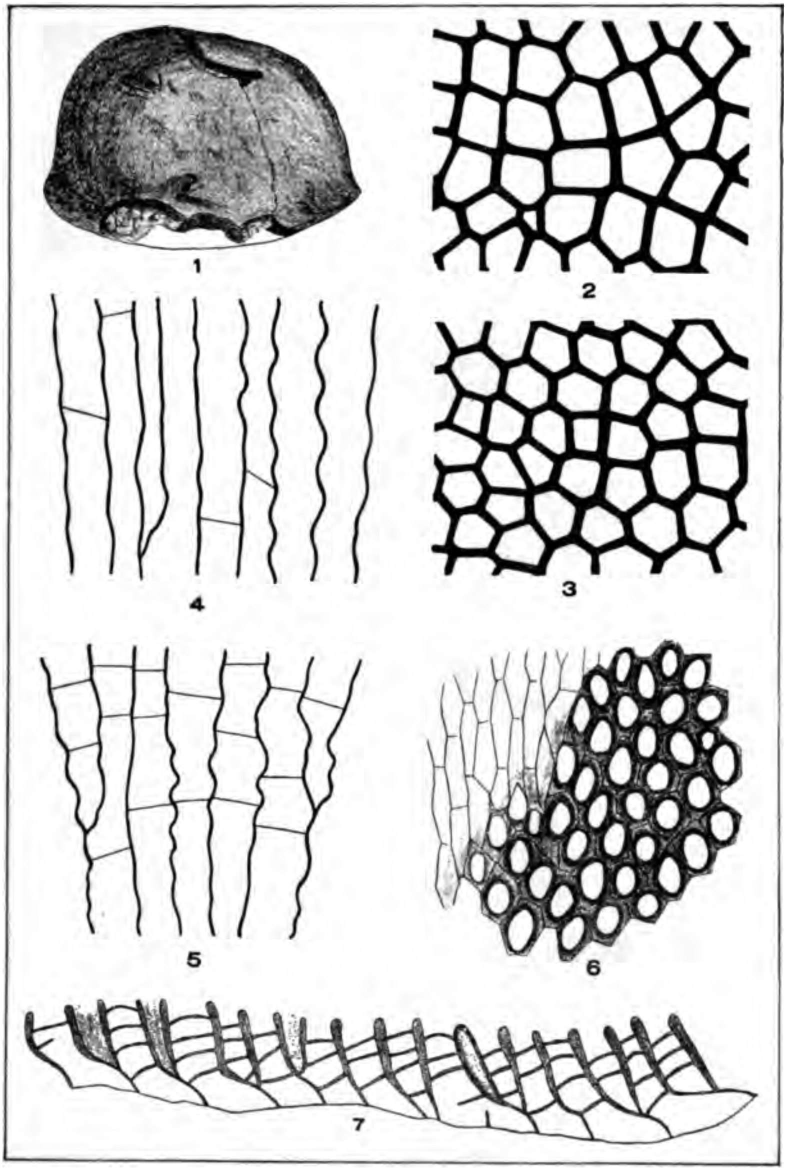

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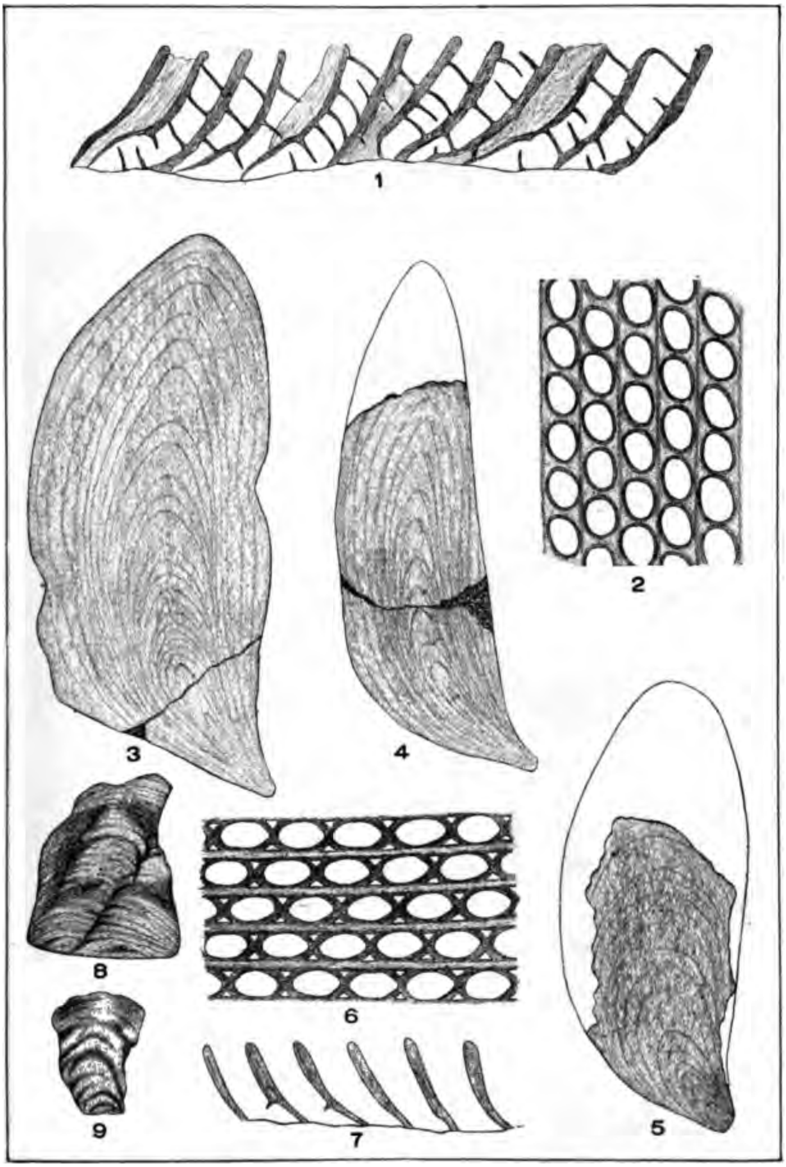

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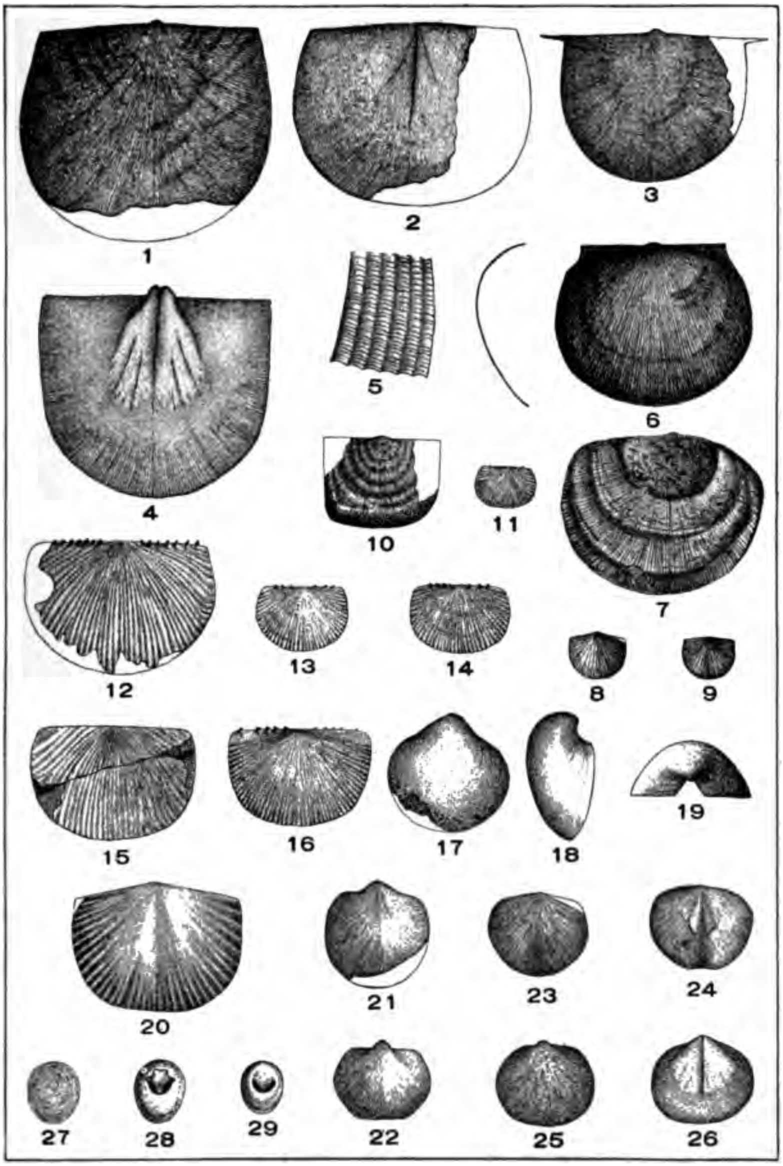

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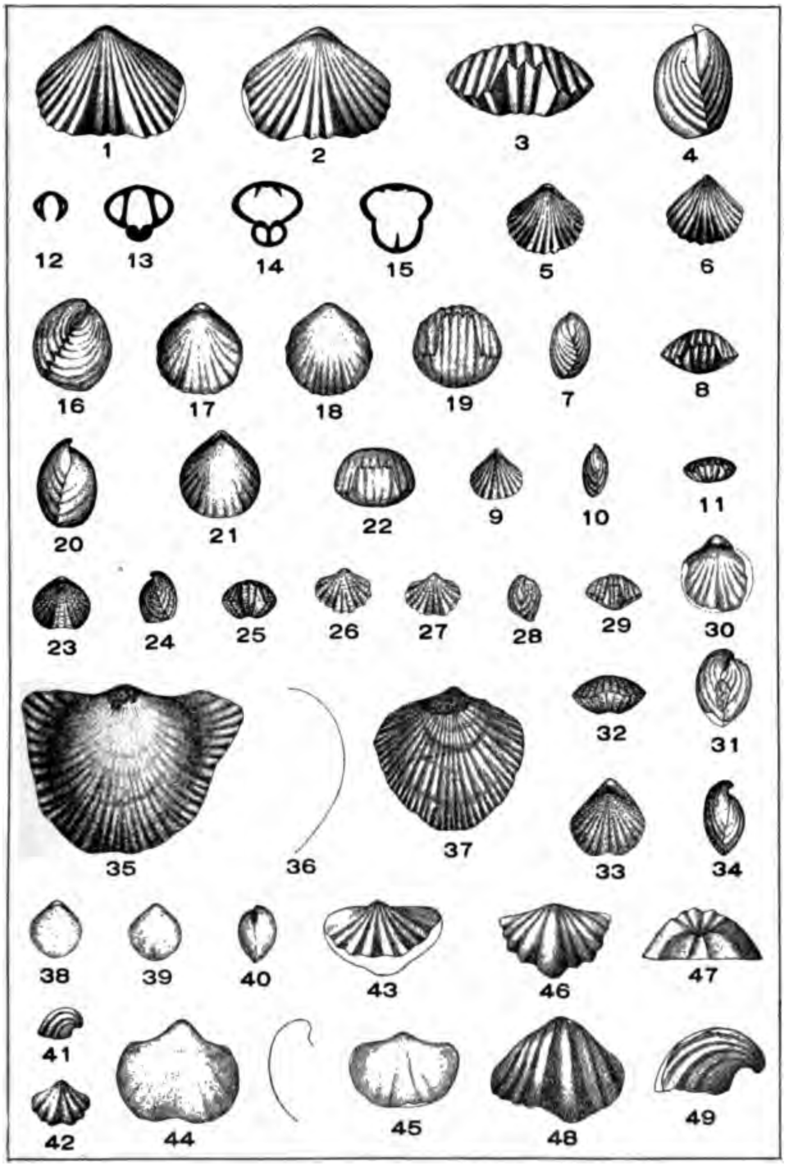

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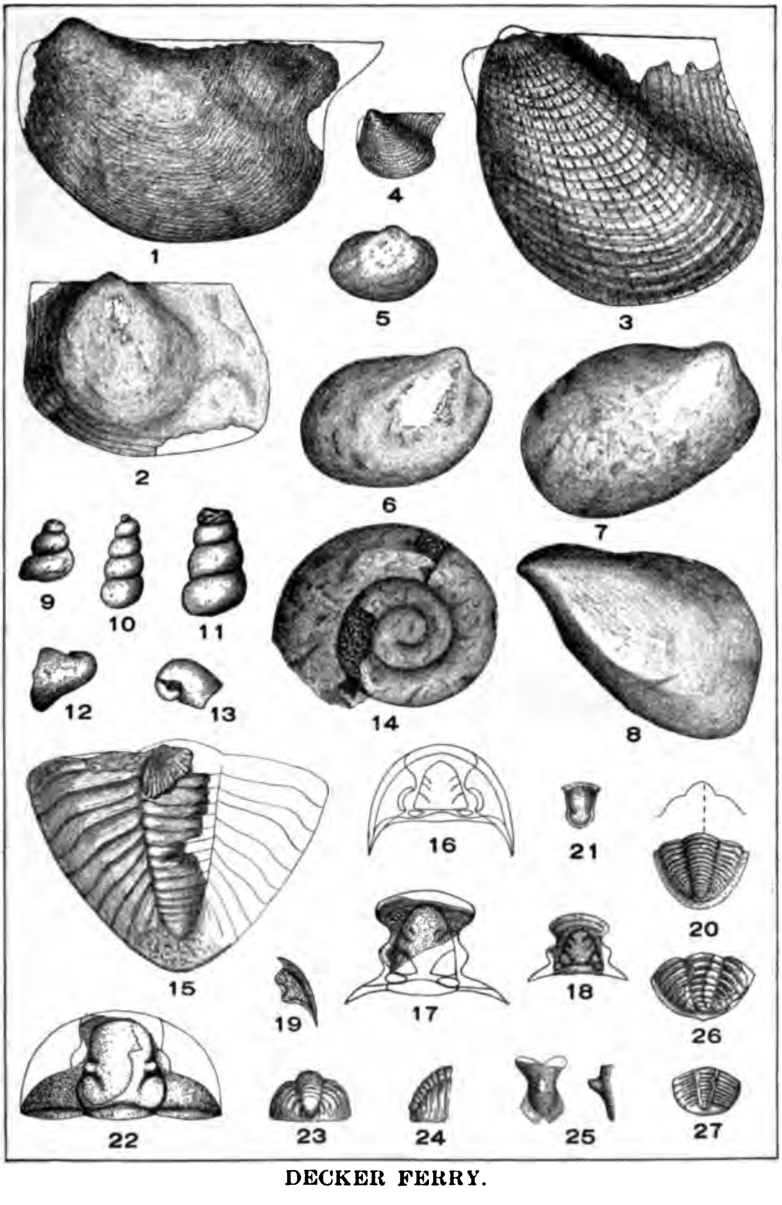

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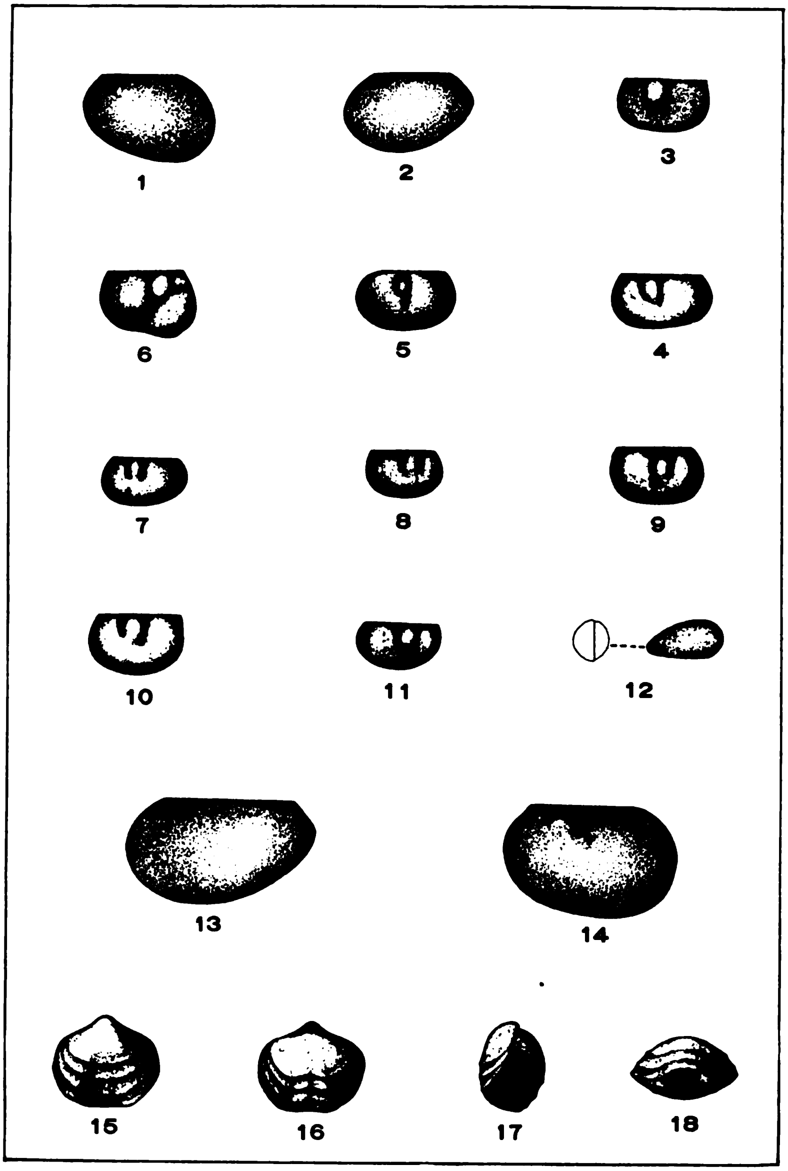

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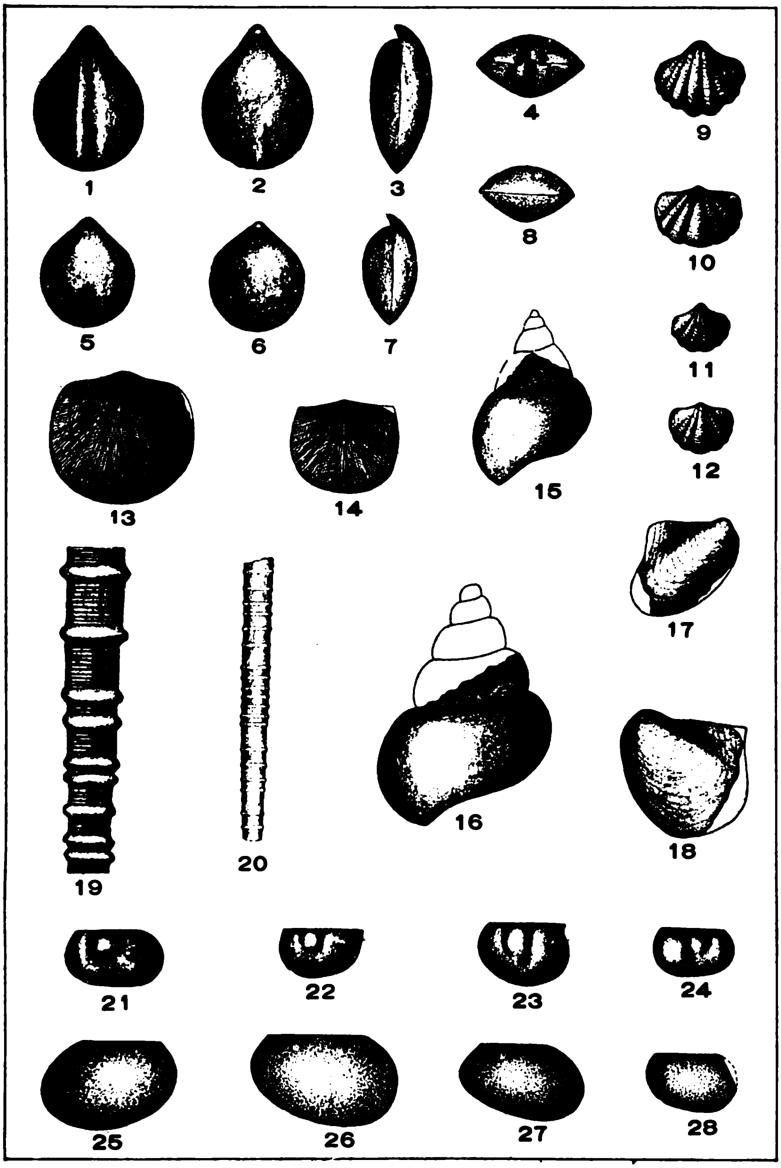

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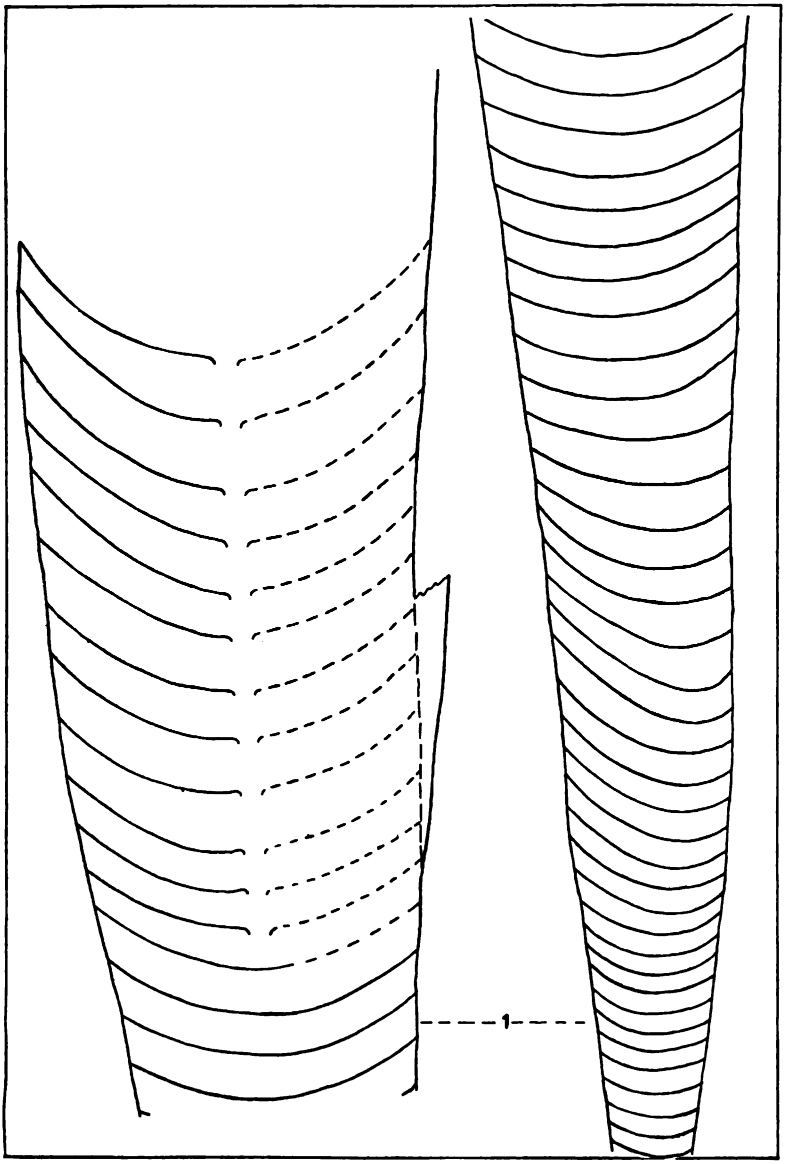

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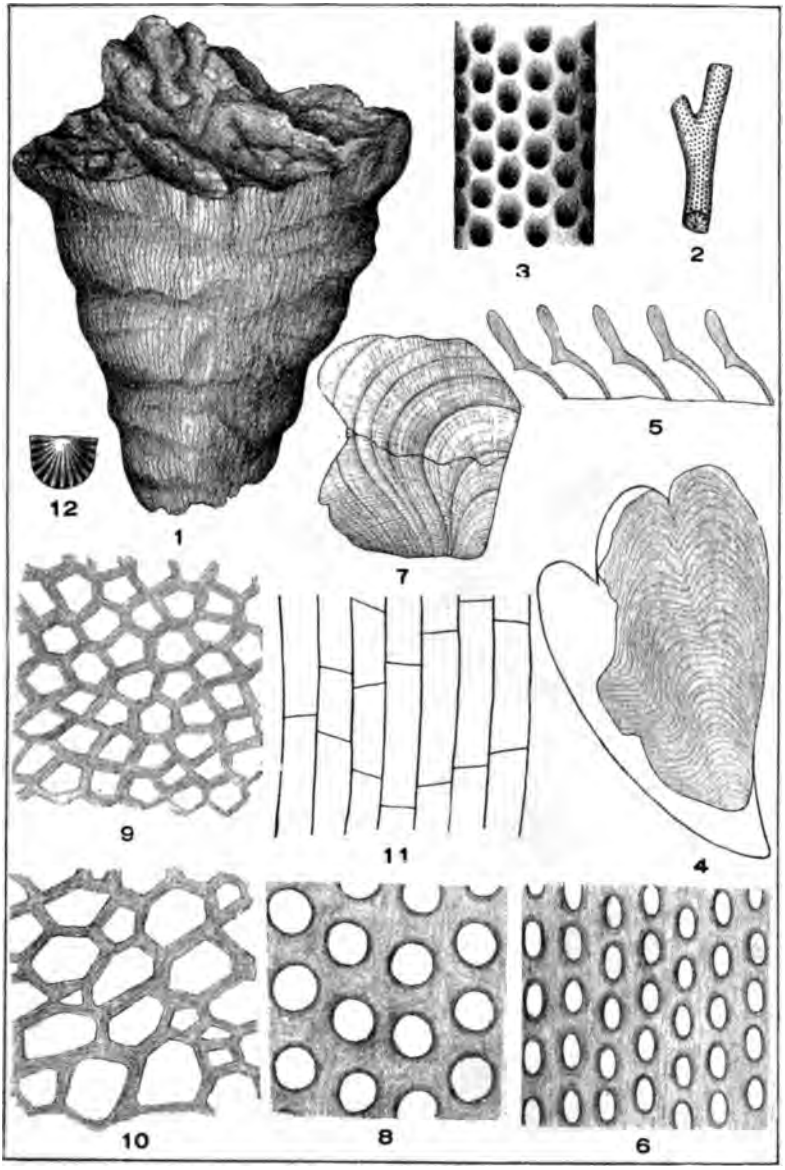

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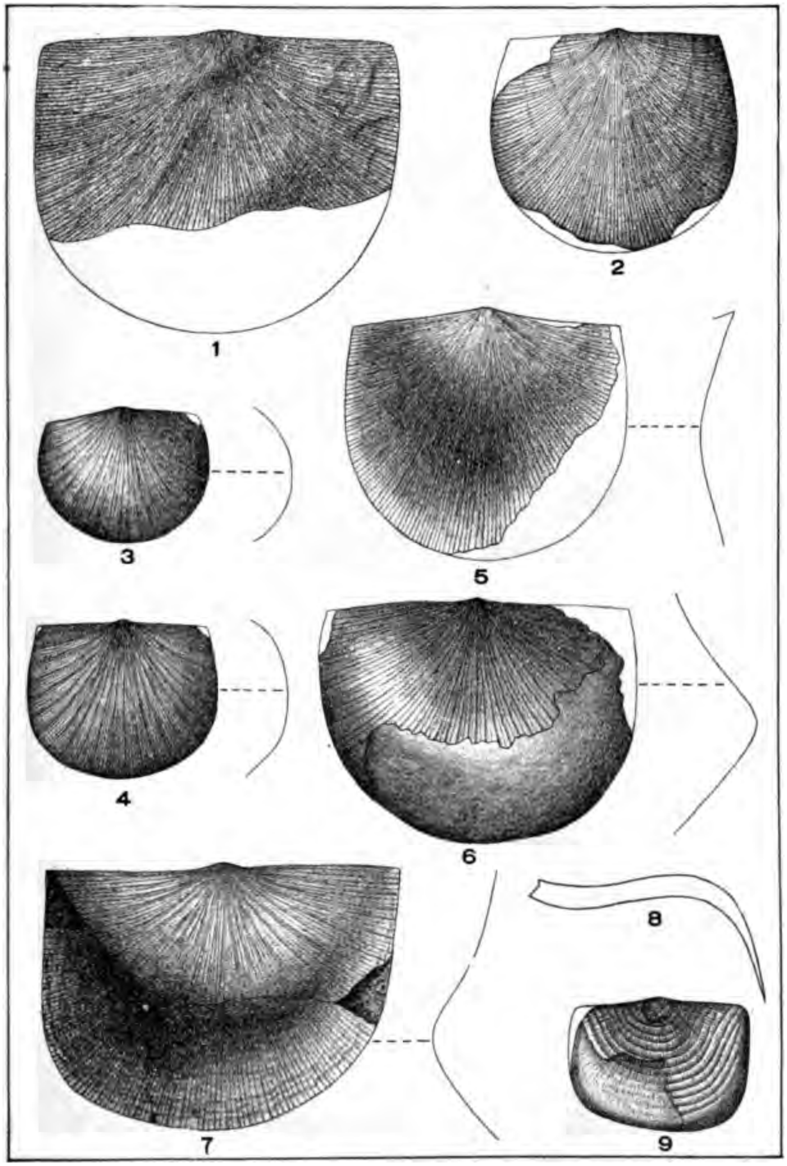

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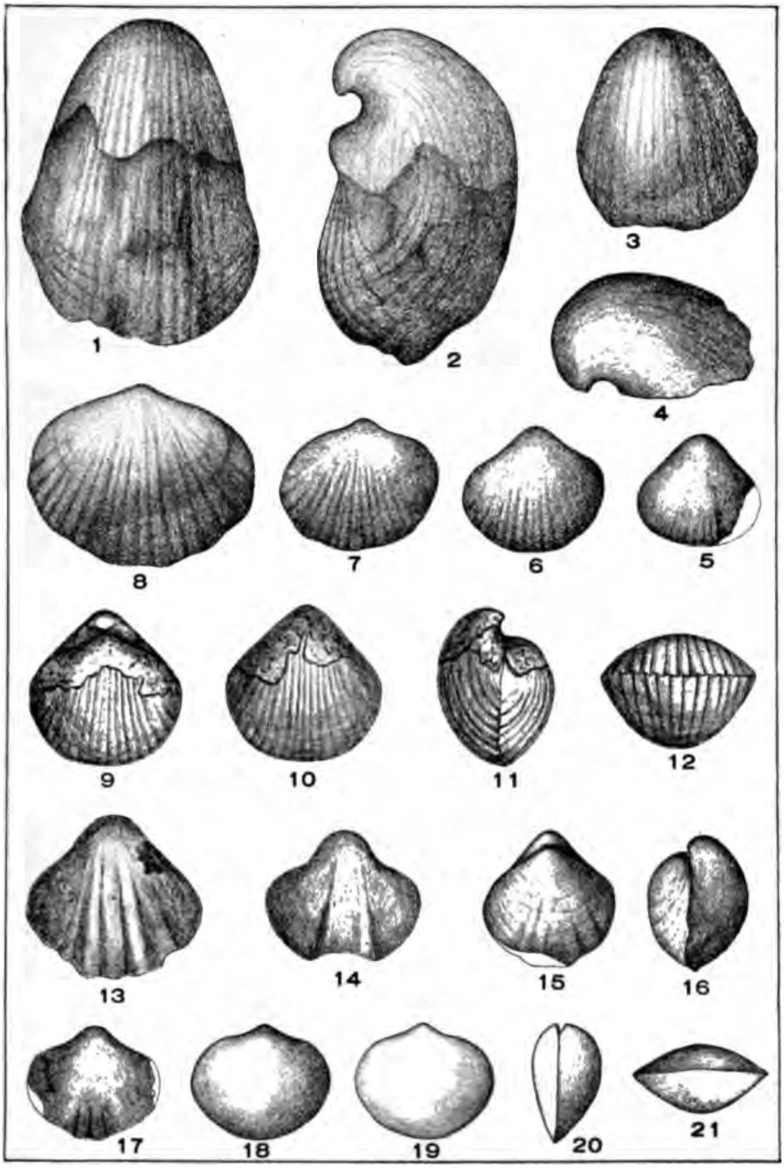

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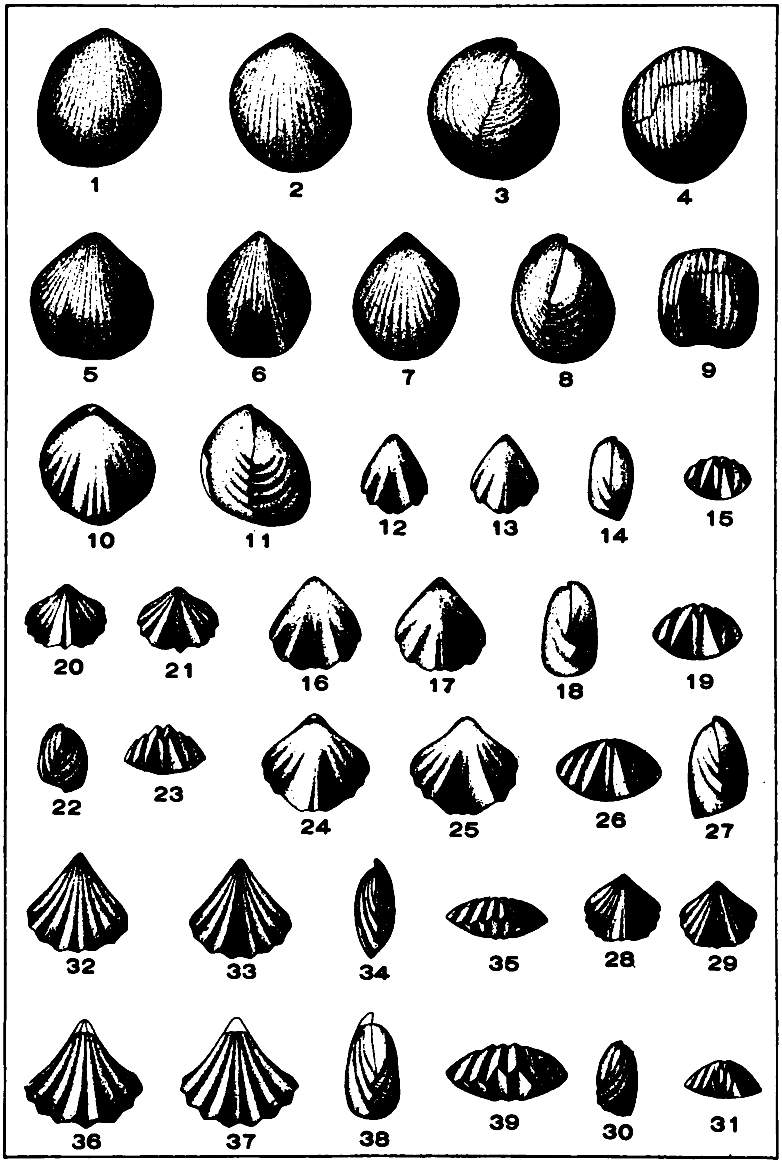
24–27. Brachial, pedicle, anterior and lateral views of a complete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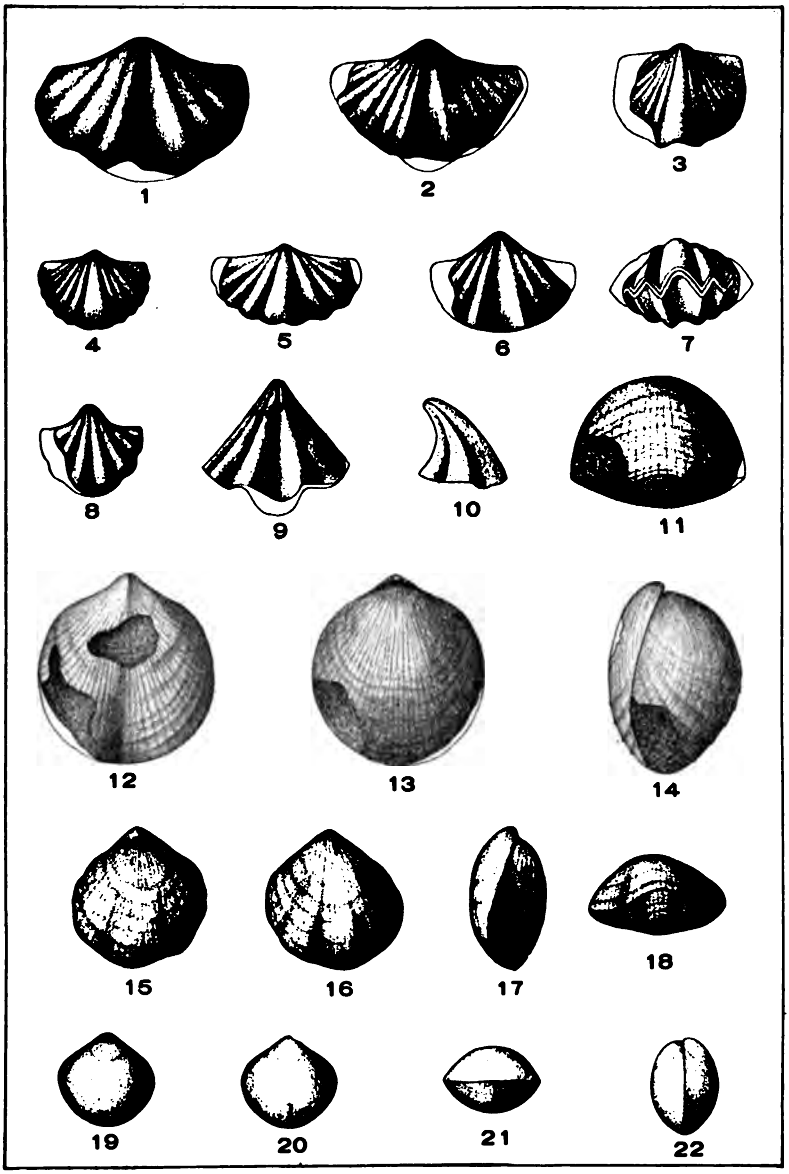

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Fig. 16. A complete left valve. *Near Hainesville, Locality 15c.*

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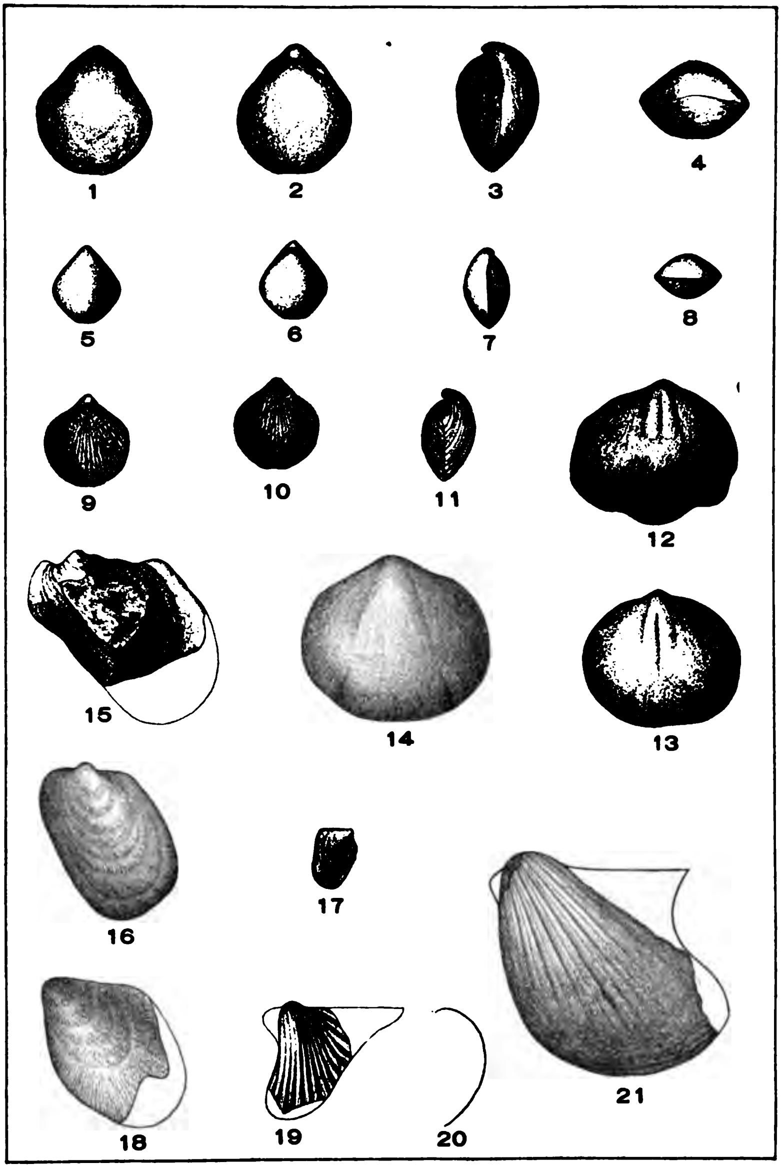

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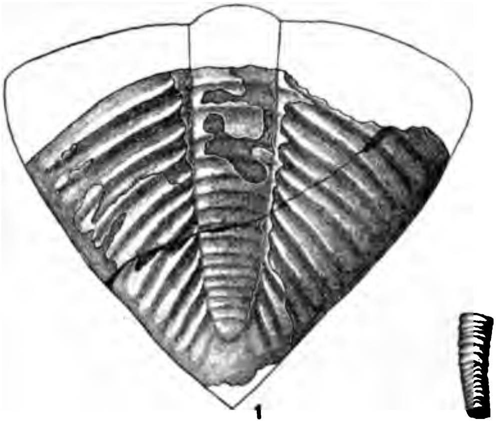
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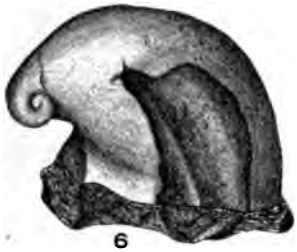
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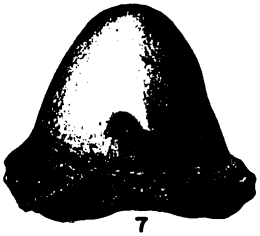
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Fig. 1. Cross-section of a globular specimen (after Hinde).
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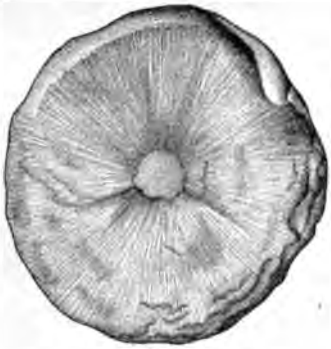

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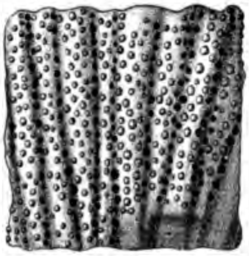

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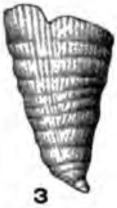

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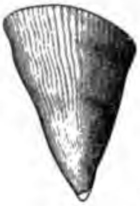

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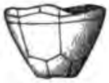

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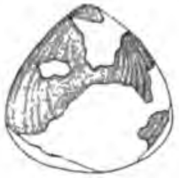

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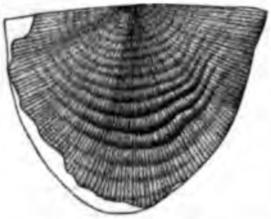

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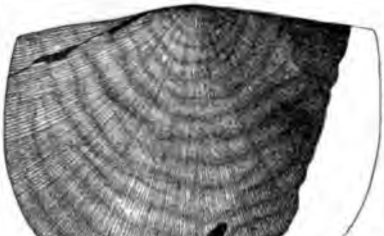

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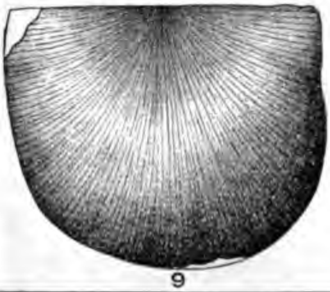

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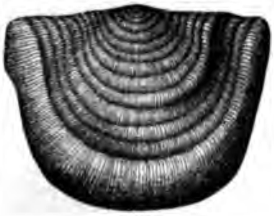

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Figs. 1, 2. Brachial and lateral views of a full-grown individual (after Hall).

3. View of an incomplete pedicle valve. *Hainesville, Locality 25 C.*

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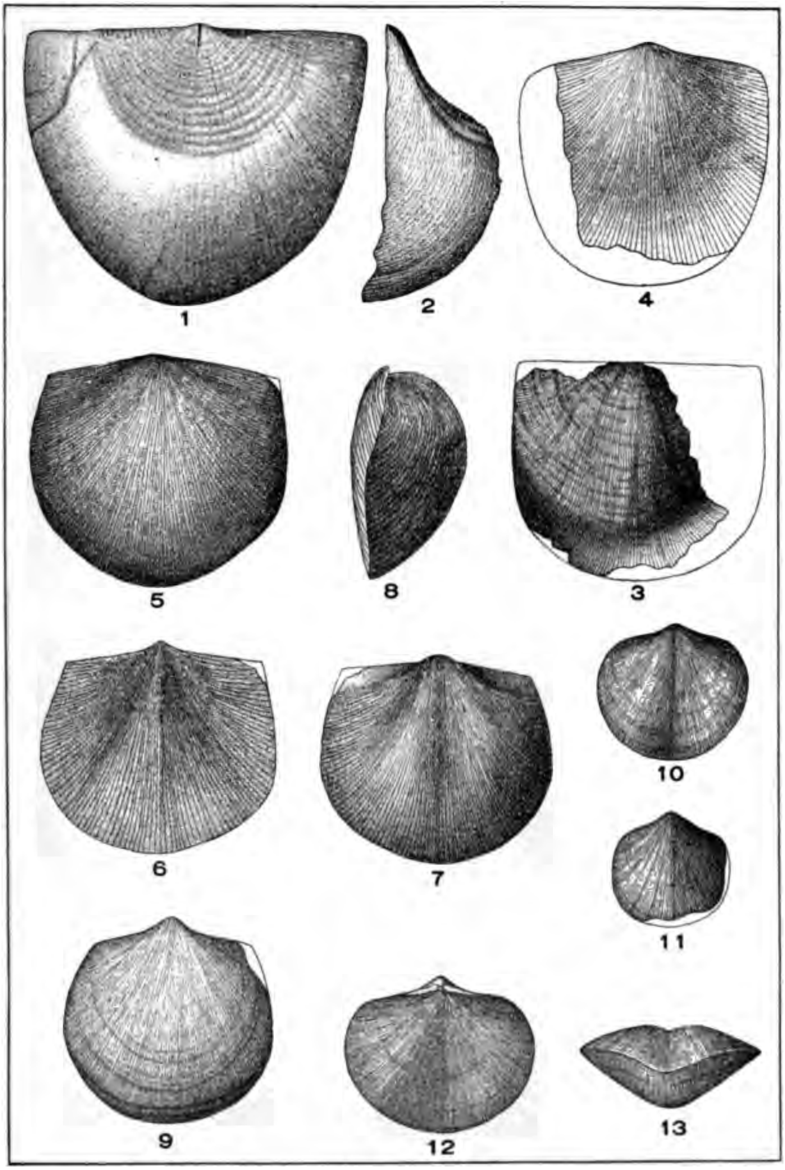
Fig. 9. A nearly complete pedicle valve. *Nearpass section, Locality 2 A.*[29]

DALMANELLA SUBCARINATA (Hall)................... 306



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Figs. 1–3. Lateral, anterior and brachial views of a nearly complete individual (after Hall).
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DALMANELLA PERELEGANS (Hall) **305**

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13. Interior view of a pedicle valve (after Hall).

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Figs. 14–17. Brachial, pedicle, lateral and anterior views of a complete

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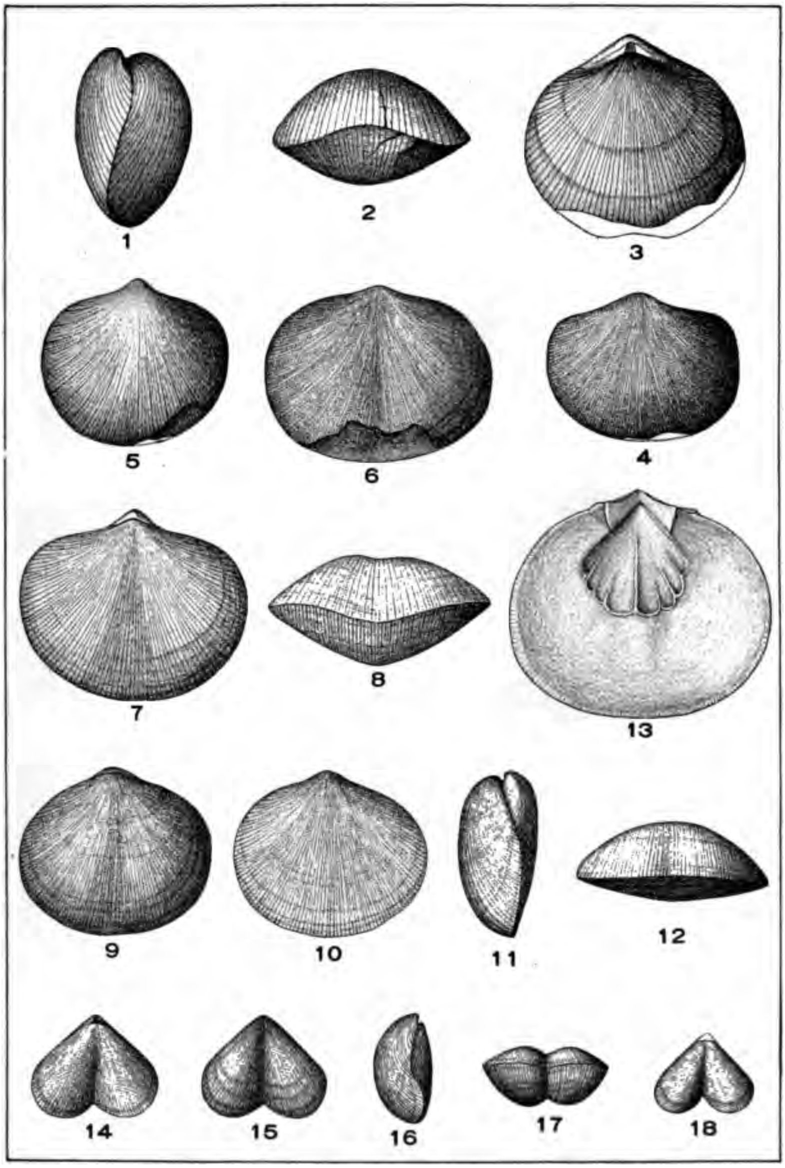

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Fig. 1. The brachial valve. Natural size (after Hall).

2–4. Anterior, posterior and brachial views of a complete individual, enlarged (after Hall).

UNCINULUS VELLICATUS (Hall) 308

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RHYNCHOTREMA FORMOSA (Hall)? 309

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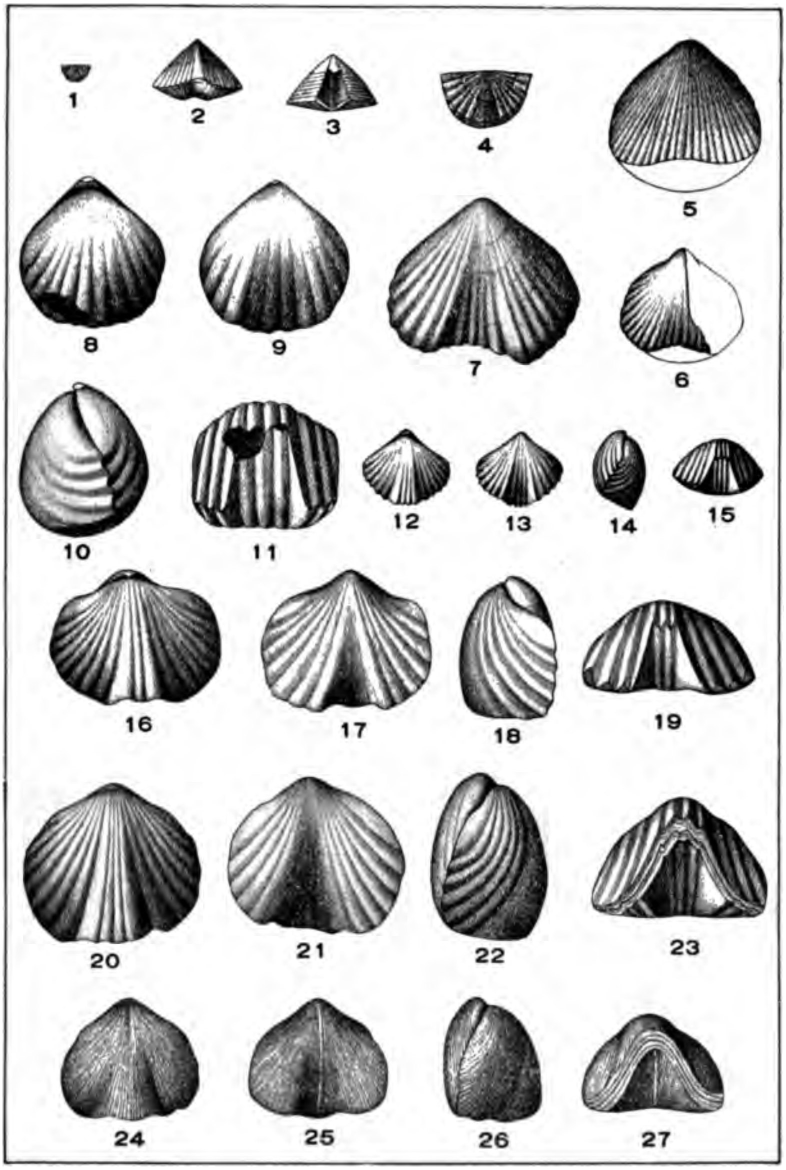

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Figs. 1, 2. Pedicle and anterior views of a complete individual (after Hall).

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ANOPLOTHECA CONCAVA (Hall) 316

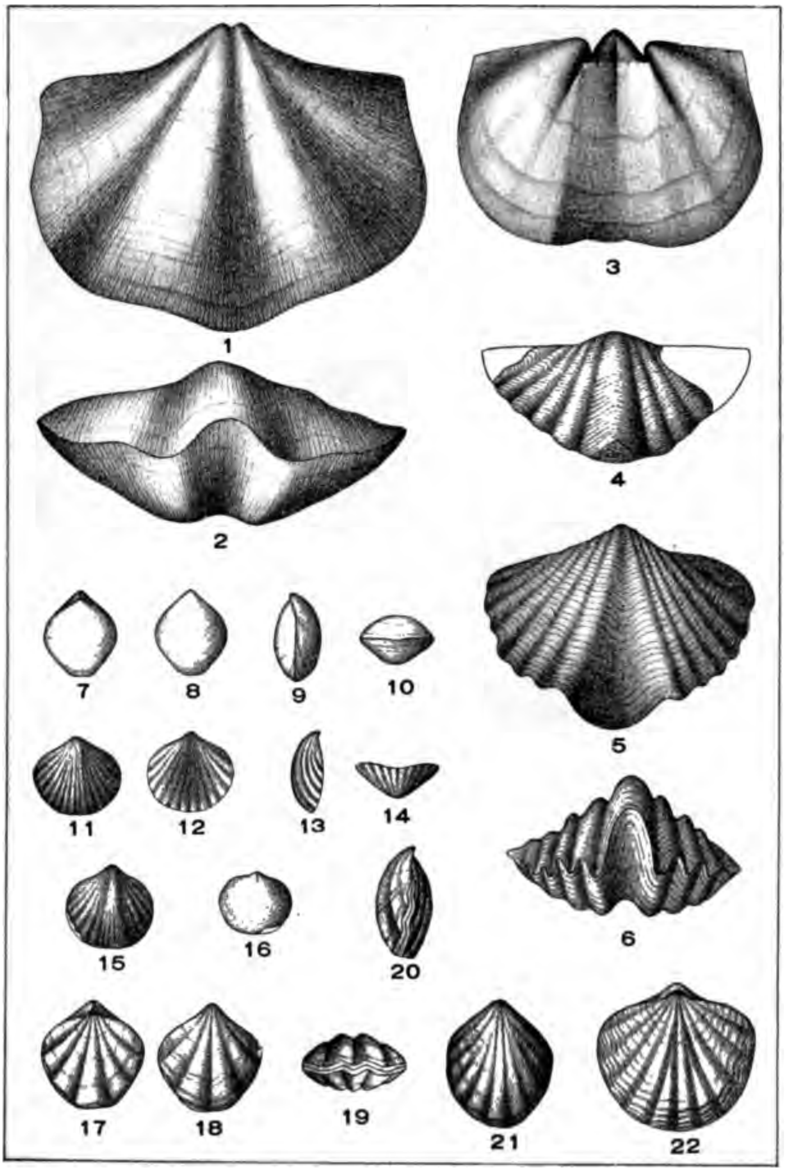
Figs. 11–14. Pedicle, brachial, lateral and anterior views ofa complete individual. *From Schoharic, New York.* Pal. Coll Walker Museum, University of Chicago, No. 8,522. (x 2).

15. A pedicle valve. *Hainesville, Locality 25 D.* (x 2).

NUCLEOSPIRA VENTRICOSA Hall 316

Fig. 16. An incomplete pedicle valve. *Locality 8 A.*

ATRYPINA IMBRICATA (Hall) 312



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Figs. 1–4. Brachial, pedicle, anterior and lateral views of a complete individual. *From Schoharie, New York.* Pal. Coll. Walker Museum, University of Chicago, No. 8,455.

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6. A nearly complete pedicle valve. *Nearpass section, Locality 2 A.*[30]

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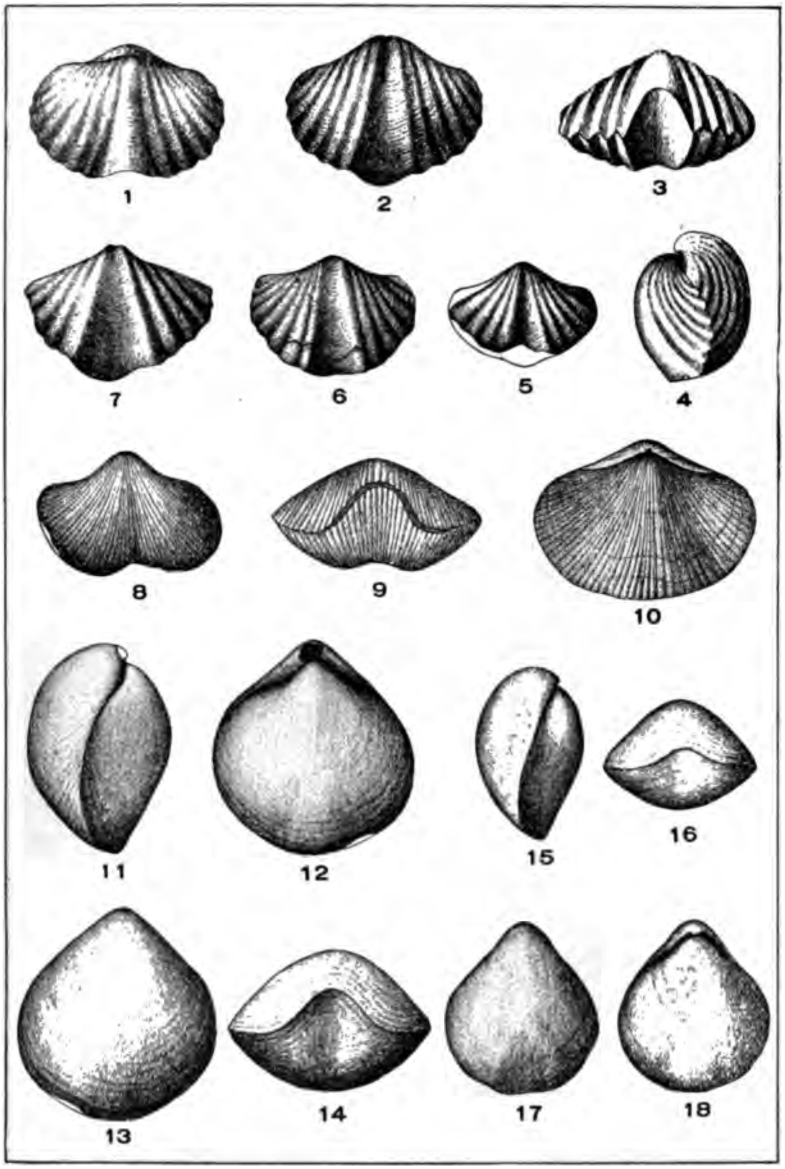

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Figs. 1–3. Three views of a nearly complete individual. *Hainesville, Locality 25 C.*

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Fig. 5. Lateral view of a nearly complete individual (after Hall).
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HOMALONOTUS VANUXEMI Hall. 321

Figs. 7, 8. Dorsal and lateral views of a nearly complete pygidium. *Nearpass section, Locality 2 A.*[31]

DALMANITES PLEUROPTYX (Green) 322

Fig. 9. An incomplete pygidium. *Nearpass section, Locality 2 A.*[29]

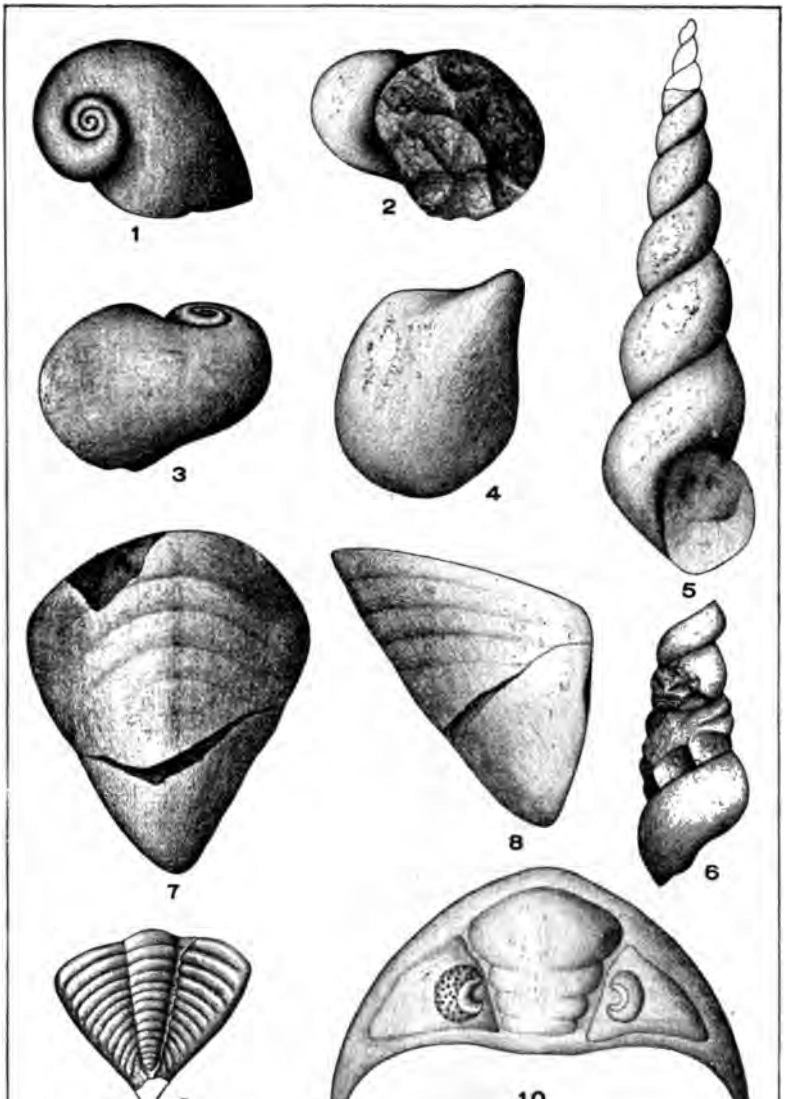

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Fig. 1. Impression of the doublure of the posterior portion of a fragmentary pygidium. *Nearpass section, Locality 2 A.*[n]

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PHACOPS LOGANI Hall.............................. 321

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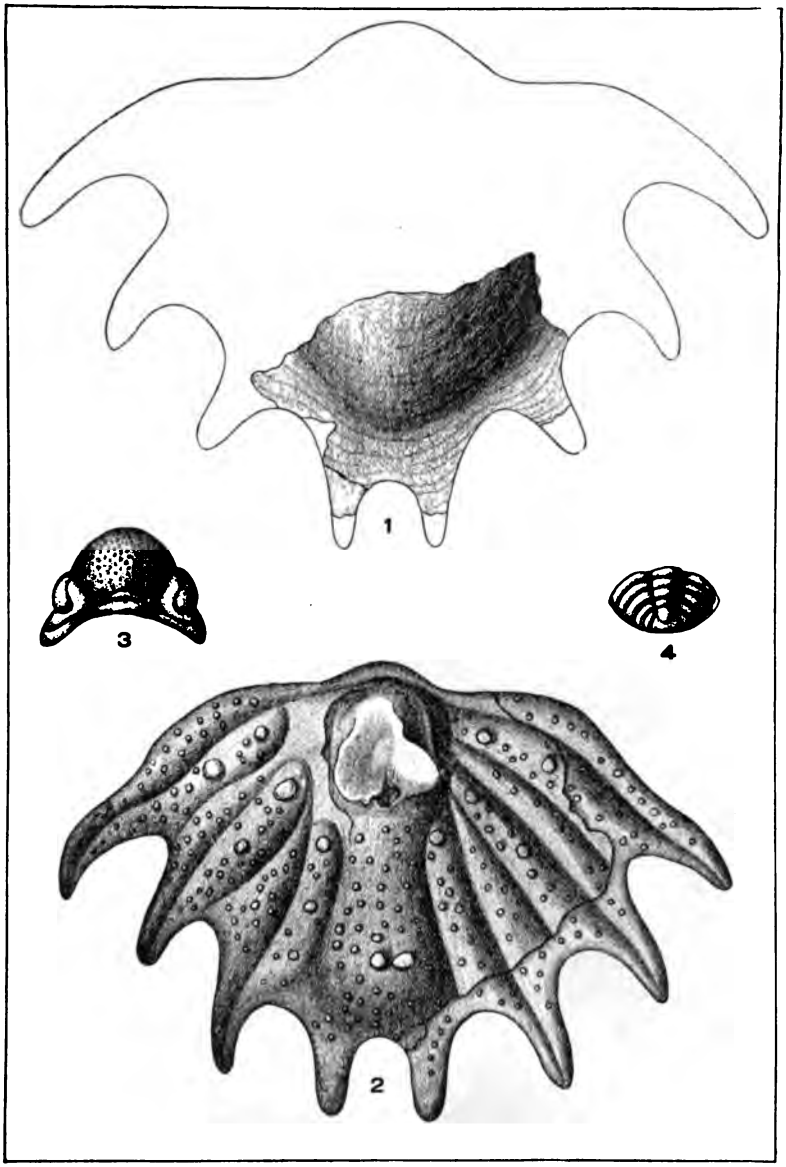
4. A nearly complete pygidium. *Hainesville, Locality 25 C.*



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STROPHEODONTA MAGNIFICA (Hall)................... 324

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Fig. 7. External impression of a brachial valve. *Nearpass section, Locality 2 A.*[33]

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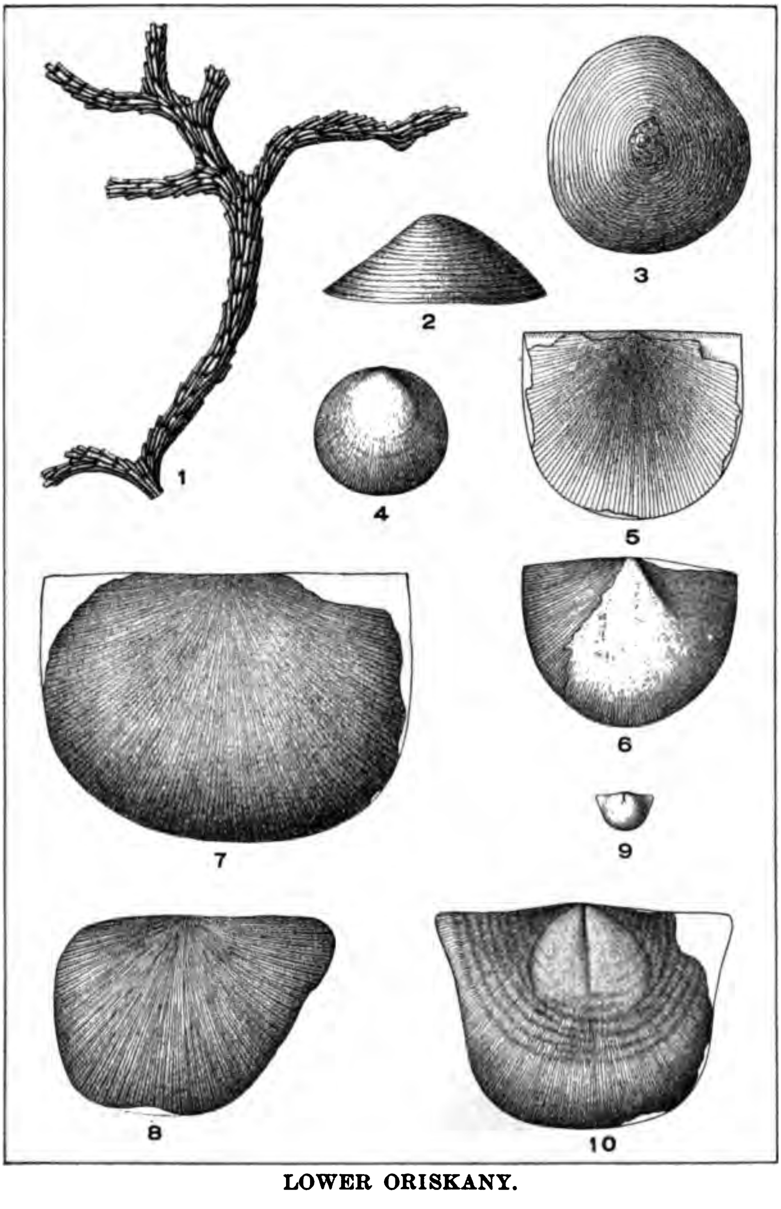
ANOPLIA NUCLEATA Hall............................ 325



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RENSSELAERIA SUBGLOBOSA n. sp.................... 329

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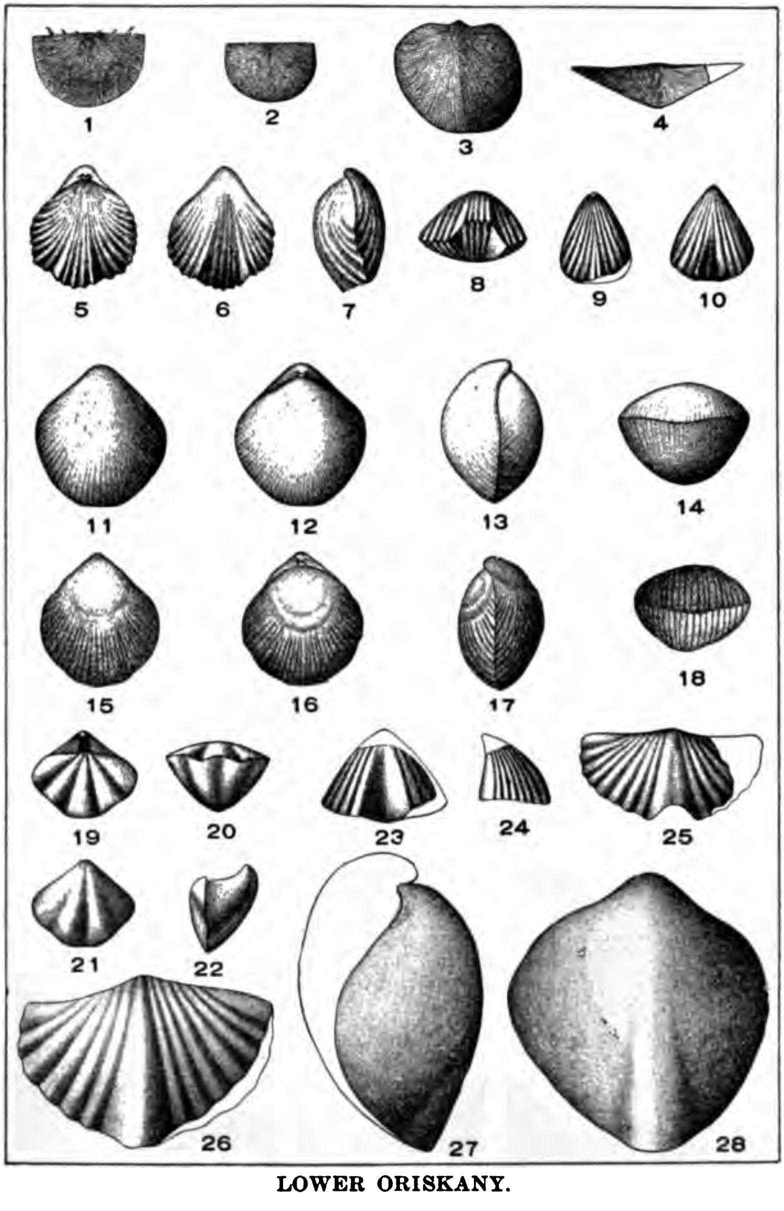

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Figs. 1, 2. Two views of a nearly perfect individual. *Nearpass section, Locality 2 A.*^{33} (x 2).
3, 4. Two views of little larger nearly complete individual. *Same locality* (nat. size).

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Figs. 5, 6. Two views of a nearly perfect individual. *Nearpass section, Locality 2 A.*^{33} (x 2).

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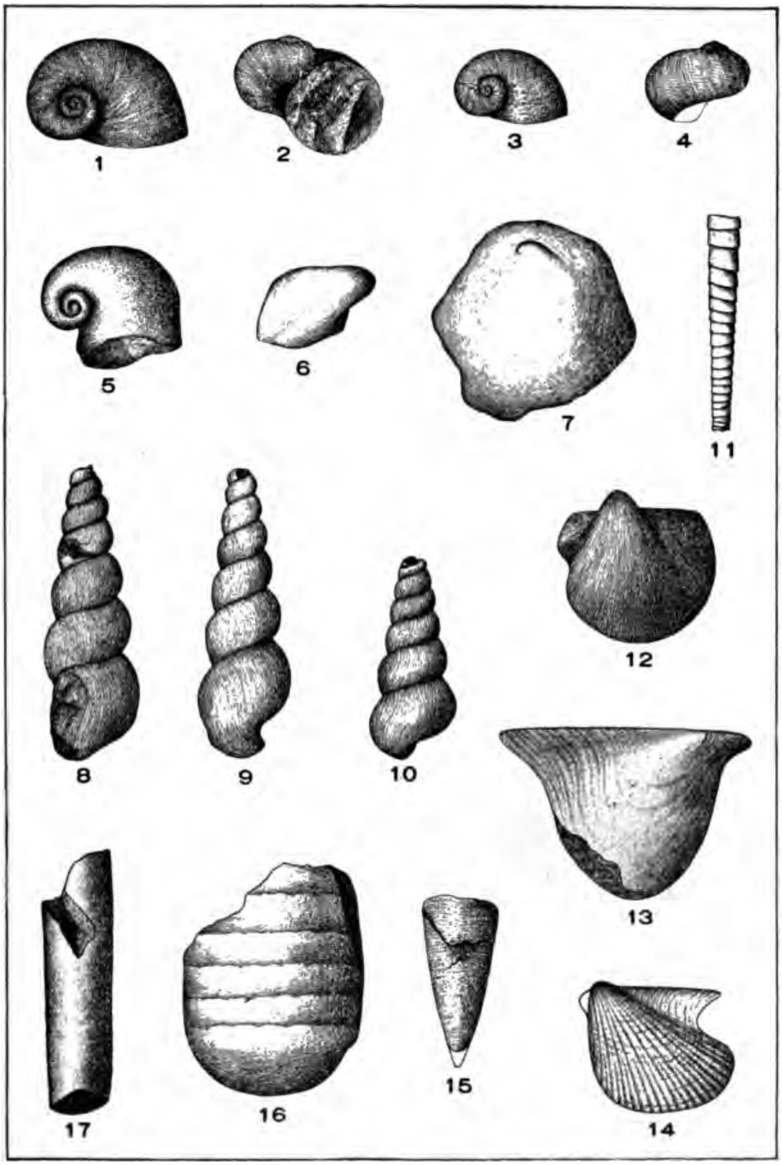
MEGAMBONIA PARVA n. sp. **333**

Fig. 12. A nearly complete left valve. *Nearpass section, Locality 2 A.*^{33} (x 2).

ACTINOPTERIA TEXTILIS (Hall) **332**



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	6.	An incomplete cranidium. *Nearpass section, Locality 2 A.*[33]	
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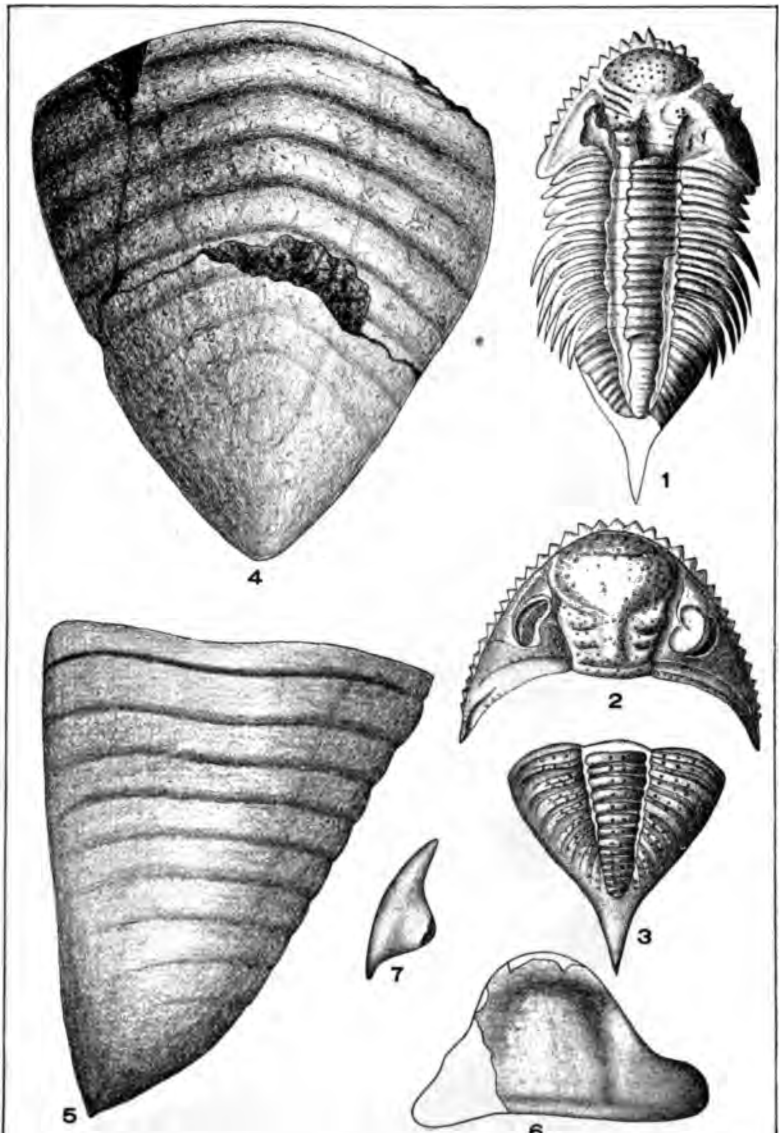

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Fig. 1. Portion of a corallum. *Locality 6 A.*
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EDIOCRINUS SACCULUS Hall. 342

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Fig. 6. The internal cast of a nearly complete valve. *Near Layton, Locality 37 A.* (x 2).

ORBICULOIDEA JERVENSIS Barrett. 343

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ORTHOTHETES sp. undet. 347

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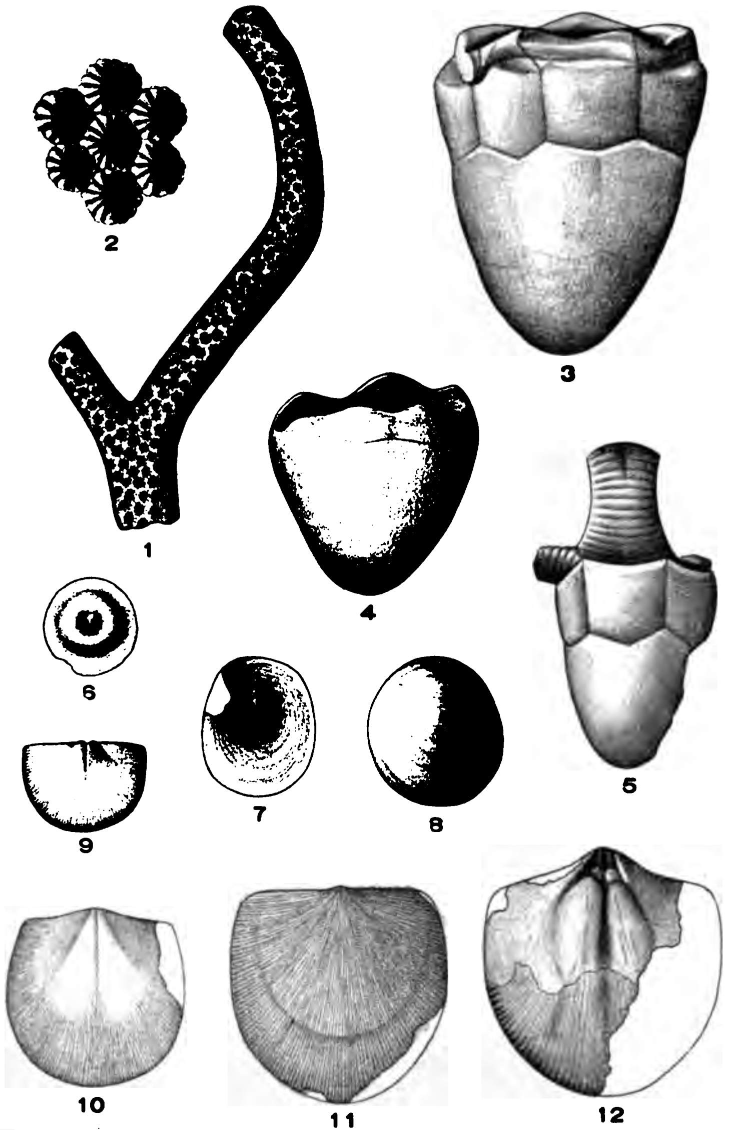

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RHYNCHONELLA BREVIPLICATA n. sp. 350

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Fig. 5. A large, incomplete brachial valve. *Locality 6 A.*
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Fig. 8. The internal cast of a pedicle valve. *Near Layton, Locality 37 A.* (x 2).
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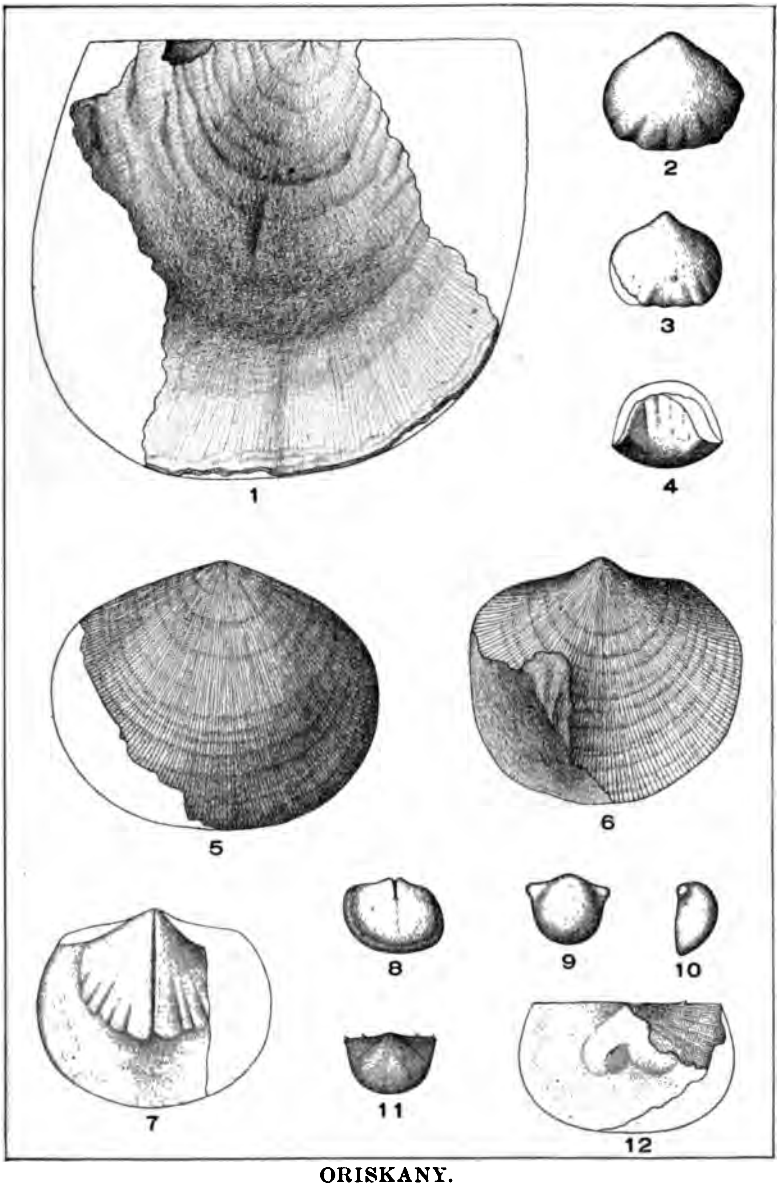

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Fig. 1. Lateral view of a nearly complete individual, showing denticulate margin of valves. ***Peters Valley, Locality 53 B.***

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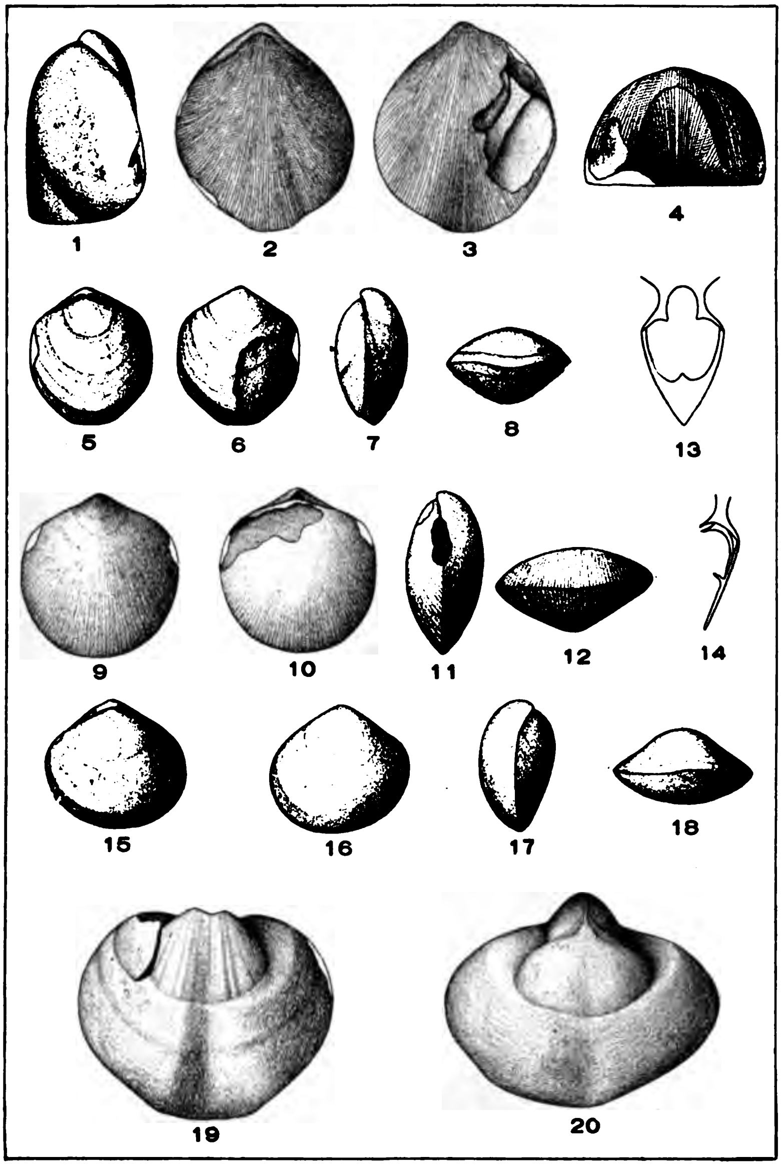

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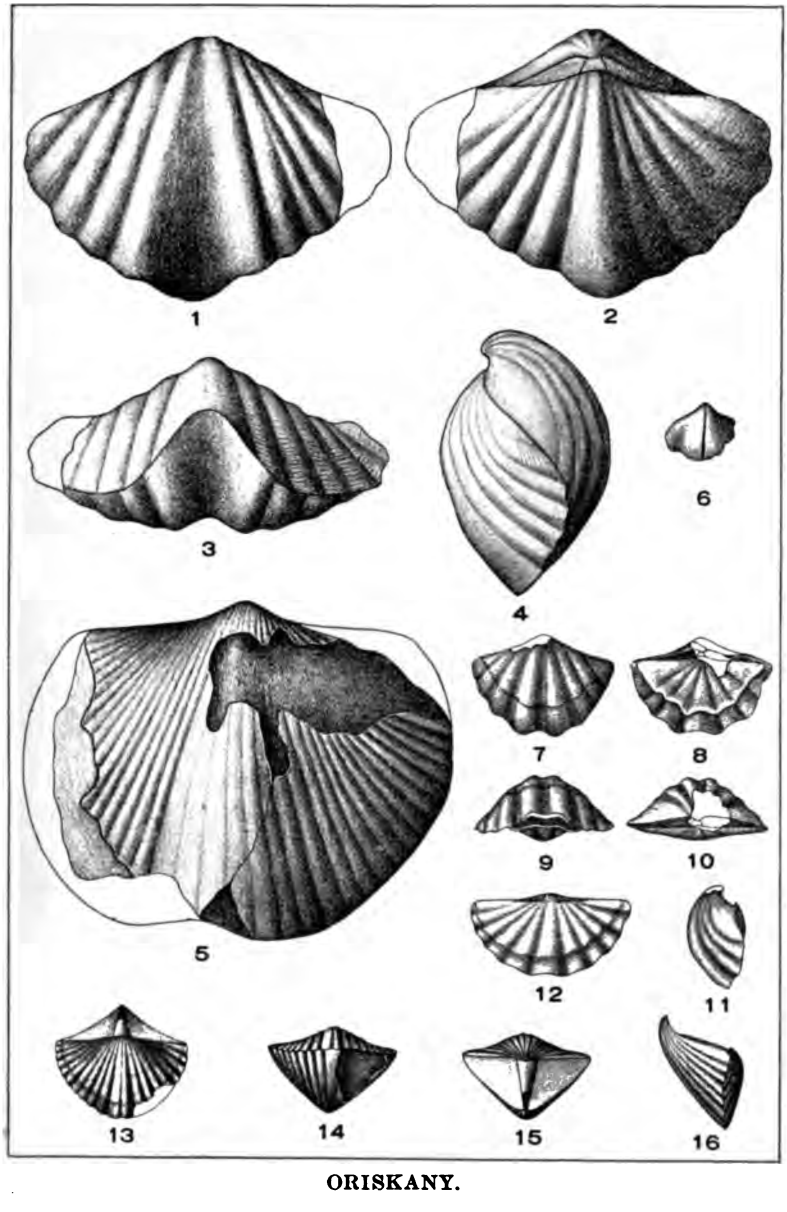

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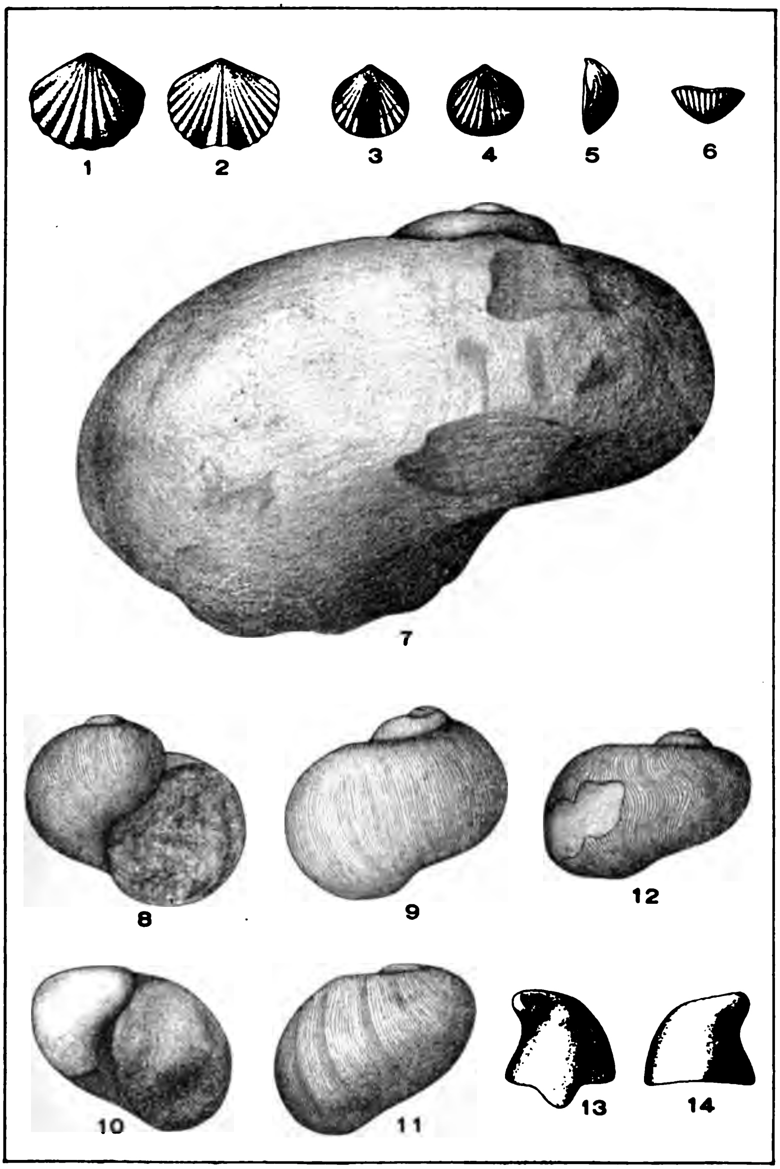

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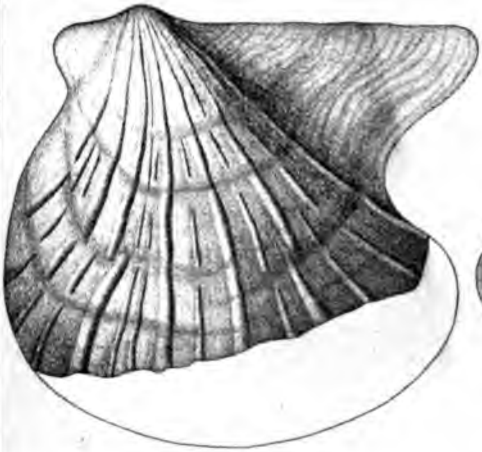
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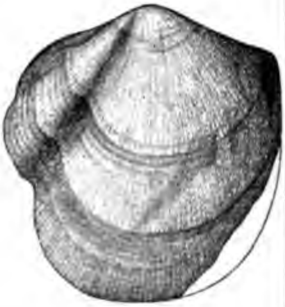
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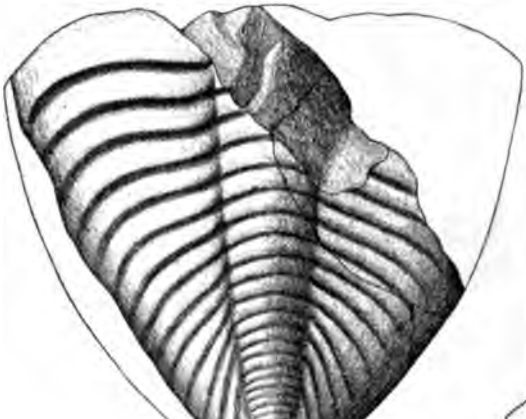
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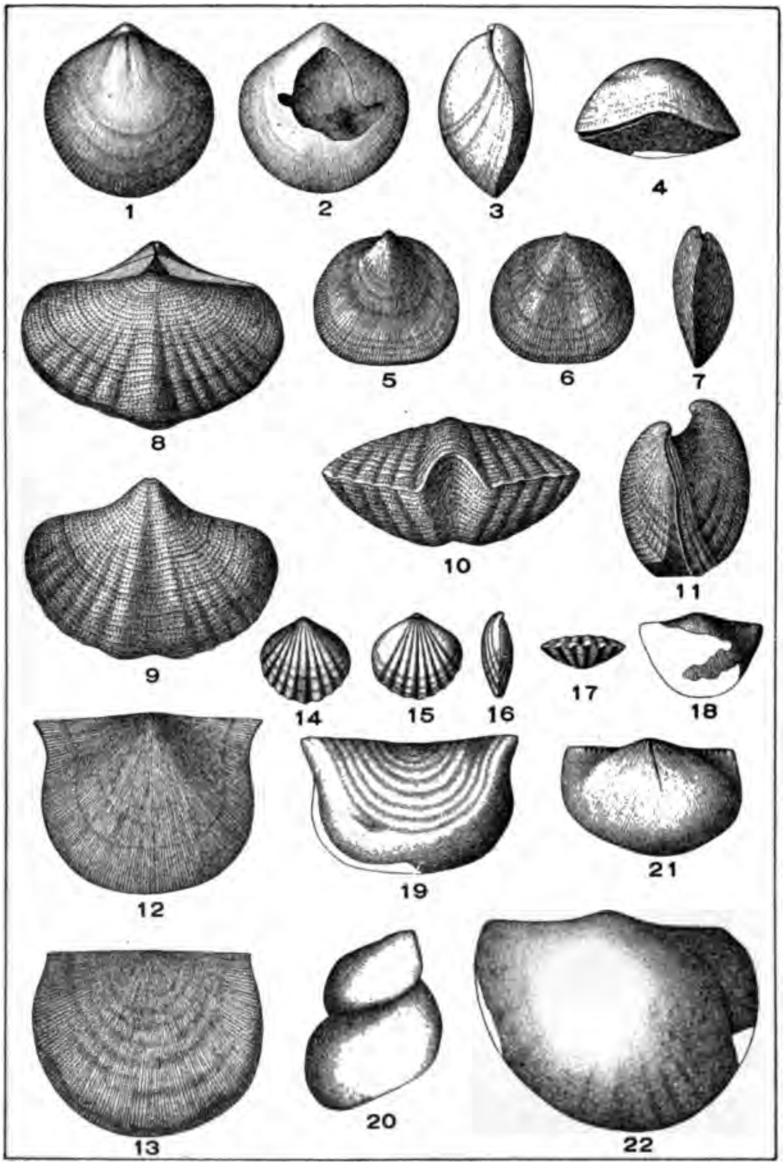

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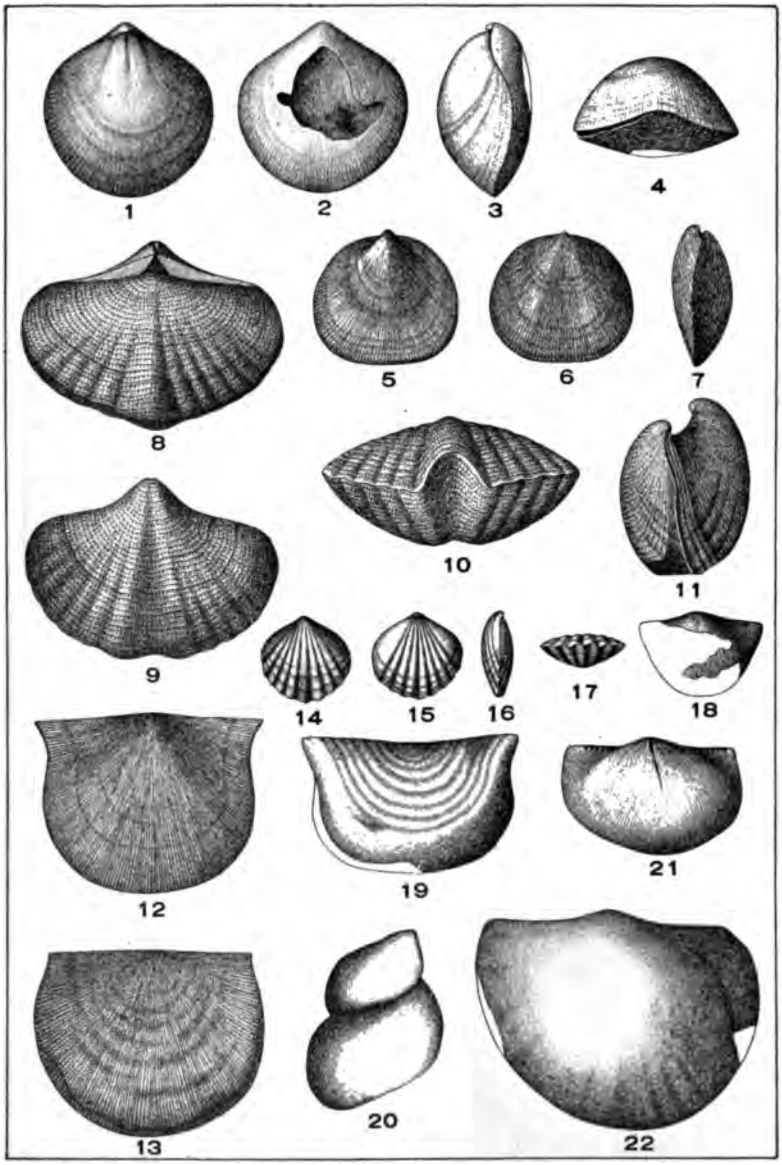

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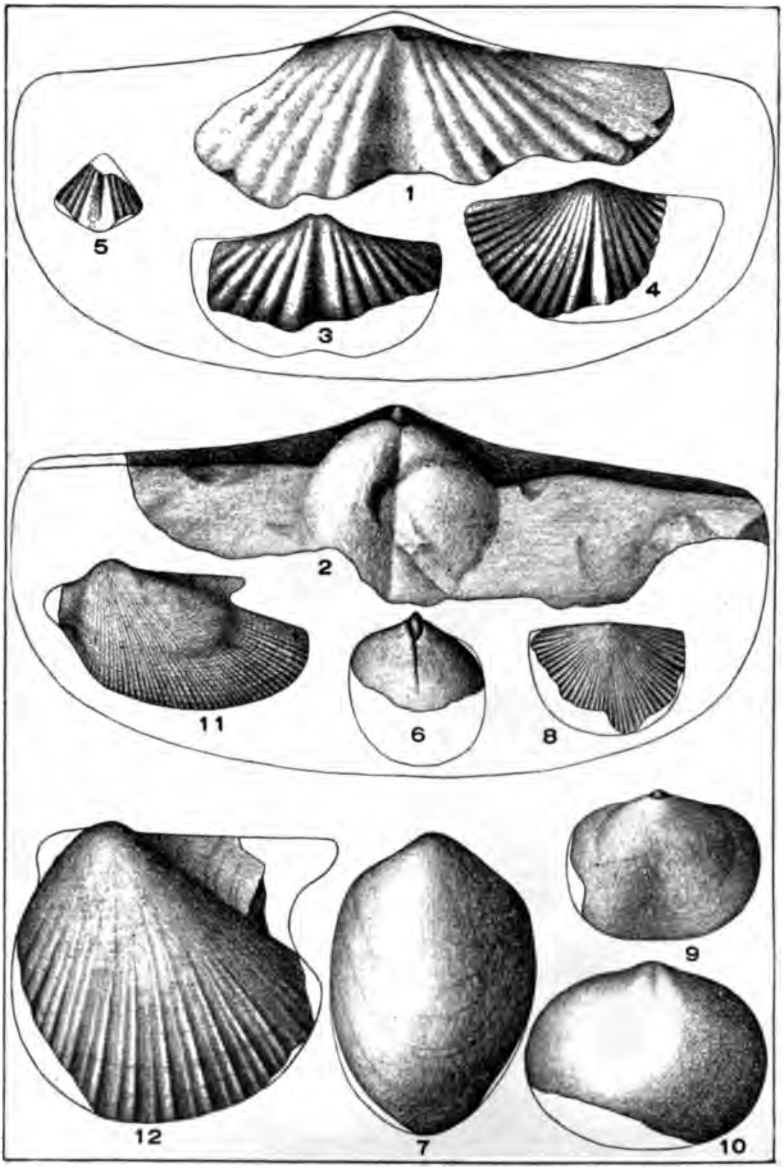

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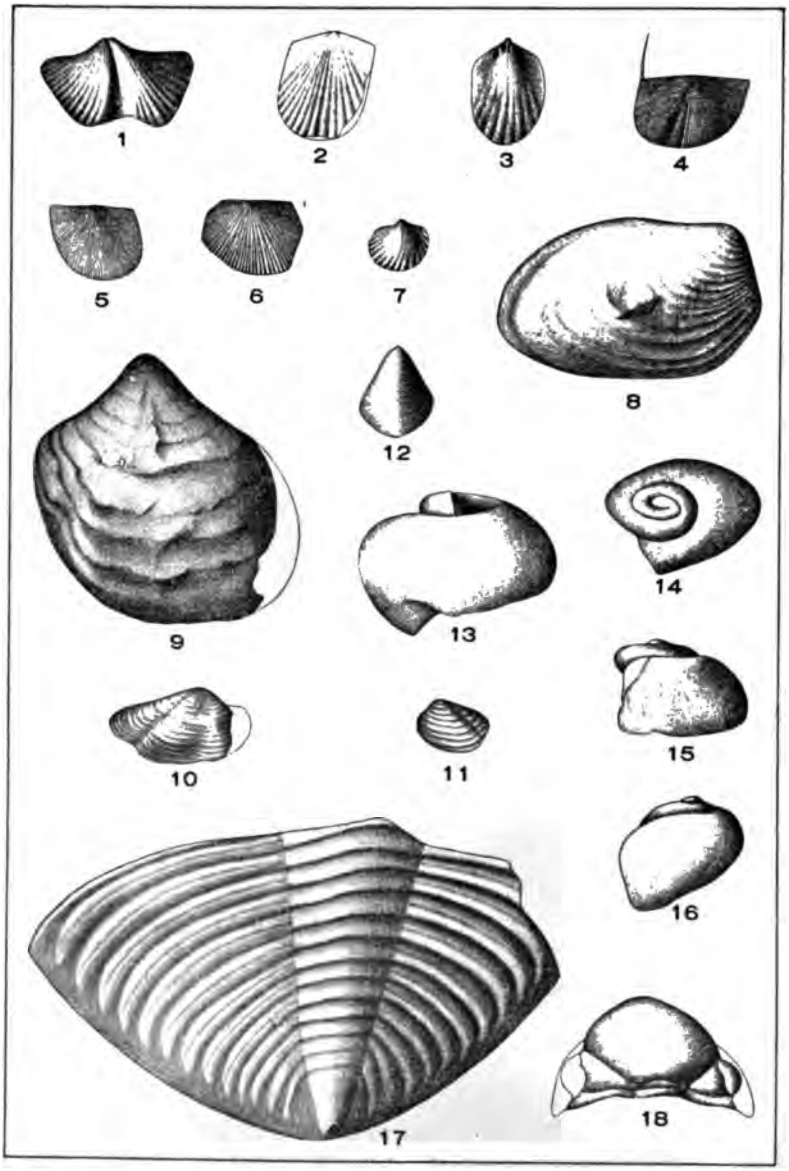

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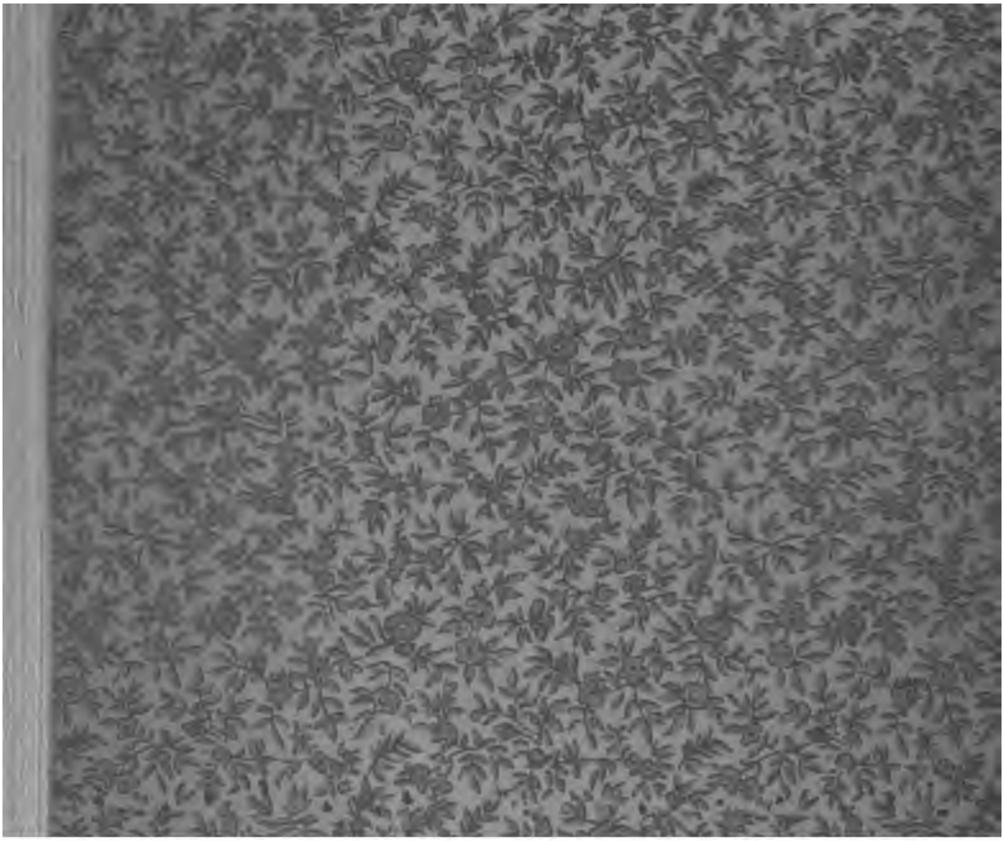

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